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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

MARCH 10.

Institute of Metals (Swansea Local Section):—Ordinary meeting. "Some Researches on the Wire-Drawing Process," Paper by Prof. F. C. Thompson.

North-East Coast Local Section:—Ordinary meeting at Newcastle-upon-Tyne. "The Extraction of Copper," Paper by R. D. Biron, M.Sc.

MARCH 11-12.

Institute of Metals:—Annual general meeting, also annual dinner in London.

MARCH 12.

Institution of Welding Engineers:—Ordinary meeting in London. "Cast Iron To-day," Paper by A. B. Everest, B.Sc., Ph.D.

Institute of British Foundrymen.

MARCH 7.

Lancashire Branch:—Ordinary meeting at Manchester. "The Blast Furnace: Its Limitations and its Relation to the Cupola," Paper by H. G. Scott.

MARCH 10.

Lancashire Branch (Burnley Section):—Annual general meeting, also discussion, opened by W. Barnes.

Training in Russia.

A scientific man, who recently visited Russia to advise the Government on technical education, has expressed his astonishment at finding over there a system of technical education more carefully thought out than ours, and being developed on a scale which makes English technical education look very small. The Russian student is not so comfortably housed, fed or accommodated as the English student, but, perhaps, that only encourages them to work harder. Buildings and equipment are described as magnificent. They have completely abandoned the polytechnic system of technical education and set up a system of what may be called monotechnics, each school studying one subject and being associated with a works where the products studied are made. This specialises the students sooner, but it makes them productive sooner, and this is very important to the success of the five-year plan. The ideal of general education, either by intention or on account of the pressure due to the plan, has been abandoned. The students get a good deal through social service, and under the régime now adopted there is no uncertainty as to what a student is going to do in life.

There are now in Russia 188 technical schools of university rank, which is probably double that of the whole of the British Empire. These schools have at present nearly a quarter of a million students, costing one and a-quarter million roubles per annum. The hours worked are nearly double those worked in England, and amount to 50 per week. The student is regarded as a State employee and paid a salary. This ensures regularity in attendance, hard work and a willingness to go to any school dictated by the authorities.

As an illustration, there is at Moscow a technical high school, originally a machine-tool factory. The students, of which there are over 400, learn to make cutting tools on production lines. The unemployed are also provided with craft training, which has a good moral effect as well as instilling craftsmanship. They have abolished the examination system.

Thus is Russia building up a system which in a few years may startle Europe. It is a great experiment and one that we should watch with interest, for they begin without preconceived notions or traditions. They are working hard. They aim to train 750,000 unemployed workers during 1931.

A typical result of Russian engineering is the Siberia-Turkestan railway, recently completed. It takes grain from Siberia and thus frees the parched lands of Central Asia for cotton cultivation and sheep farming. They surveyed the ground and built the line in a few years, and told the world about it in a remarkable film known as "Turksib."

The Newer Cupola-Melted Metals.

The article which we recently printed on "A New Cupola-Melted Material with a 1 per cent. Carbon Content" has brought us numerous demands for more details, which now we have taken steps to procure. In the meantime it is interesting to examine just what such a process means, if the facts as revealed in our article are substantially true. Primarily, the 1.0 per cent. carbon material is virtually a tool steel of chisel temper carrying a much higher silicon content than is usual. The first question that arises is whether such a material has good casting properties, providing adequate casting temperature is available. All the information we have at the moment is a deduction from the examination of a horse-shoe casting, the skin of which told us that the casting temperature was too high for the type of sand used in the construction of the mould, for incipient fusion had taken place.

The author of the article speaks of 1,500 deg. C. as the temperature of the metal at the spout, but we place little reliance in general on this particular phase of technology. Presuming, then, that the casting temperature is adequate for the type of metal melted, one next asks whether the casting properties are suitable for making sand castings. Such material cast into ingots certainly requires carefully feeding to avoid excessive piping.

The second phase is whether one is to regard this alloy as a raw material for malleablising, a tool steel or as a high-duty cast iron. It has no right to the last designation, as the composition definitely places it in the range of steel. That on forging it gives extremely high tensile is not surprising when one examines the composition, so far as it is disclosed by the analysis shown. It is rather unfortunate that the sulphur and phosphorus contents were not given, as this would have disclosed in some small measure the percentage of steel scrap used in the charge. With the scanty information available at the moment, the domain of this steel appears to us to be that of extending the field for which malleable iron is normally used.

Another process, about which there is insufficient technical information available in Great Britain at the moment, is Meehanite metal. This is produced by a system of control and the addition of calcium silicide to cast iron, and the outstanding claim is that it carries its

carbon content in the nodular form initially. The tensile strength is reported as varying between 23 and 33 tons per sq. in. We are informed that its popularity in the States is such that it commands the same price as steel castings.

Both these developments are extremely interesting, but those responsible for their exploitation must bear in mind that there is not too much price margin before one reaches the cost of cheap steel castings; that poor casting properties create endless expense; that elasticity may be an essential or definitely detrimental; that ordinary cast iron is ameliorating continually under intelligently-controlled manufacturing conditions. However, despite these warnings and suggestions, we are convinced that there is a large and ever-widening field in engineering for the utilisation of a material having the tensile strength of steel, but without its elasticity, providing the shock-resisting strength is adequate and the machining qualities reasonable.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Molybdenum Rolls.

To the Editor of The Foundry Trade Journal.

Sir,—I have just read the leading article in the current issue of The Foundry Trade Journal in which you refer to the alloy cast-iron roll we show on the Stand of High Speed Steel Alloys, Limited. You mention Corbin's patent, of which we are also makers, and the inference might be drawn that there is some connection between the two. I would like to make it clear that this is not the case. The roll shown is a molybdenum-alloy cast-iron chilled roll. The Corbin patent is a steel roll without molybdenum, and processes of manufacture are, of course, entirely different.—Yours, etc.,

Arthur J. Burn.

The Llanelly Foundry & Engineering Company, Limited,
Llanelly, South Wales.
February 27, 1931.

The Corsalli Process.

To the Editor of The Foundry Trade Journal.

Sir,—In connection with my work on the mineralised or (more strictly) impregnated forms of the blast-furnace coke fuel in the bosh and hearth of the furnace, it follows that, if one can prevent in the cupola process the surface reactions which are a result of the impregnation of the fuel cells by the partially-oxidised portions of the charge in the form of the so-called black cinder, then one can reduce the total-carbon content almost to the proximate theoretical figure of the mixed weights of scrap and metal charged into the furnace.

The carbon pick-up of cupola-melted metal is primarily due to the gas reactions on the surface of the impregnated coke which causes the formation of oxidised siliceous cinder which necessitates the reduction of some of the carbon monoxide to carbon dioxide in order to further the melting process.

The logical conclusion is to "dip" the coke fuel in a fused lime-slag of the following proximate composition:—

SiO_2	33–31	per cent. min.
Al_2O_3	18–14	,,
MgO	4–5	,,
CaO	35–40	,, max.
FeO	0.50	per cent. max.
MnO	0.45	,, ,,
S	0.50	,, ,,

The lowest percentage of alumina being always associated with the higher percentage of lime to get the best results. This "dipping" process will coat the fuel with an average thickness of from $\frac{1}{8}$ to $\frac{1}{4}$ in. and will effectively protect it until it reaches the hearth level. The result will be that less iron is oxidised and lost as the black cinder and the fuel consumption approaches more nearly to the theoretical figure—in other words, that the efficiency of the cupola as a whole is increased somewhere in the region of 15 to 20 per cent. The slag analysis may be altered within certain ranges to vary the amount of sulphur content in the final iron tapped.—Yours, etc.,

Colin D. Abell.

Bradford,
February 27, 1931.

Book Review.

High-Speed Steel, by Marcus A. Grossmann and Edgar C. Bain. Published by Messrs. Chapman & Hall, 11, Henrietta Street, Covent Garden, London, W.C.2. Price 17s. 6d. net.

This book is divided into two main sections—(1) "Manufacture and Use," and (2) "Nature and Properties." No great amount of space is devoted to the actual melting of high-speed steel and much of that is indicative rather than descriptive, especially in connection with electric-furnace practice. Virtually the subject is dismissed by printing four data sheets. Here an examination discloses the fact that for slag making 300 lbs. of "Kendymag" was used (or was it for repairing the hearth?), 600 lbs. of lime, 300 lbs. of fluorspar—an amount which, to our mind, seems grossly excessive—as also does 300 lbs. of coke. We feel reasonably certain that two slags have been used, and would have expected some ferro-silicon to be used, but, although in two cases none was added, yet 0.36 and 0.28 per cent. was yielded up to the metal from nowhere, unless it came from a reduction of the silica content of "Kendymag" or the roof bricks. We notice from these data sheets that 7 or 8 bath-sample analyses are got out during the run, and it would be interesting to learn how they managed to prepare drillings for laboratory tests within a reasonable time. We know of no published information on this point. We have referred to these data sheets, because we are perfectly sure that the authors were convinced that their inclusion would replace much descriptive matter, but for those unfamiliar with American practice it merely leads to confusion.

The use of cast-iron borings in the ends of the containing pipes during the annealing of high-speed bars, to prevent surface oxidation, in preference to coal or coke, appeals to us as being a sensible innovation since we supervised this particular process. We were particularly pleased to note that with rare exceptions all the temperatures are given in Centigrade as well as in Fahrenheit. The same regard for British readers is shown by the use of "tempering" for the American word "drawing." The only quarrel we have with the authors' nomenclature is the use of the word "inhomogeneity" in place of "heterogeneity."

Much of the early development work, we are told, on vanadium in high-speed steel was done by J. A. Mathews, yet we have always ascribed this to the late Prof. J. O. Arnold.

Part II, which deals with the nature and properties of high-speed steel, covers such subjects as the constitution of the alloy, metallography and the functions of the individual alloying elements. It is perfectly obvious that the authors have a wealth of experience at their backs; they have kept well to their subject and have produced a book which will be well received by the British metallurgist as presenting the American angle on a branch of metallurgy which, though of American origin (Taylor and White), is largely a British development.

The book contains 173 pages, 111 illustrations, and is adequately indexed. The experiences and conclusions of the authors are virtually in agreement with Sheffield practice except in some minor but important details.

Random Shots.

The past week has been one of great misfortune and disaster to me. Last Thursday morning I met a friend at Victoria Station. "D'you know that the head cashier of the K—— Y—— Insurance Company has absconded?" he asked. "But—but I thought *you* were the head cashier," I stammered. "I am. Goodbye!" he replied; and boarded the Golden Arrow.

* * *

A *lapsus linguæ* on Friday probably has lost me a fortune. I happen to be cursed with absent-mindedness and blessed (?) with a very opulent, very patronising father-in-law. Encountering me along the Strand this worthy cried: "Ha! my boy, for a long time I've been wanting to run into you." My answer was sincere and instantaneous. "Yes? And for a very much longer time I've been wanting to run over you!"

* * *

In Saturday's *Daily Flail* appeared my signed review of Major Thrashem Scarlett's "Memoirs of a Bengal Sahib." I was horrified to notice that my compliment of "battle-scarred hero" inadvertently had been printed as "battle-scared Nero." The major joined me at breakfast—a surprise visit—gaily swinging his dog-whip. We had a pleasant little chat together (the major was absorbed in the topic of physical violence), during which I telephoned the editor of the *Flail* and drew attention to his gross error, insisting upon an erratum appearing in Monday's edition. This was promised, and the major shortly afterwards departed, hinting pleasantly at another call on Monday.

* * *

Throughout Sunday I was dogged zealously by a member of the Lord's Day Observance Society. (He has to thank *me* for seeing the new comedy film, "Hot Lips.") On Monday I rose with the newspaper boy to read the *Daily Flail*. This is the correction the hard-of-hearing editor had inserted: "A typographical error unfortunately crept into our Saturday review of 'Memoirs of a Bengal Sahib.' In a reference to the author (Major Thrashem Scarlett) the phrase 'battle-scared Nero' was used. This, as our reviewer points out, should have read 'bottle-scarred pierrot.'" I packed my bag and left the house three minutes before the major arrived.

* * *

And now, on Tuesday afternoon, I am reclining in the Editor's sanctum, disguised as a theatre call-boy and endeavouring to think sweet, serene thoughts. How sad that man should yield his noble dignity to violent, brute-like passion and——

* * *

[*Wednesday.*—Major Thrashem Scarlett cornered "Marksman" on the office stairs yesterday afternoon. The editor of the *Daily Flail* has acknowledged his second mistake not only with a front-page report of the assault but also with grapes and calf's-foot jelly.—Editor.]

Marksman.

The Venting of Dry-Sand Moulds.

ELIMINATING THE COKE BED.

The meeting of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, held in the Bradford Technical College on February 7, was devoted to the presentation and discussion of a Paper by Mr. E. Flower (Manchester) on "The Venting of Dry-Sand Moulds." This Paper was published in The Foundry Trade Journal of April 18, 1929, after having been given to the Lancashire Branch, and was illustrated by lantern slides. In the absence of the Branch-President (Mr. H. Sayers), the chair was occupied by the Senior Vice-President (Mr. A. S. Worcester).

The Chairman said Mr. Flower had given them a very straightforward explanation of his method of working. He had supported his advocacy of the dry-sand bed by actual examples of work done, and it was important to note that he had achieved consistent success by this method, and not merely an occasional success.

The Question of Camber.

Mr. H. Forrest said the author was certainly to be congratulated both on his Paper and his results in practice, but there were some points on which members would perhaps like further information. How hot was Mr. Flower's metal in this practice? Was it hotter than the usual casting practice? One would like to know also whether Mr. Flower had any special sand mixtures in use. How did he account for the elimination of camber on the patterns?

Mr. Flower, in reply, said that a job that had to be machined must, if it were to be successful, be cast as hot as possible. In his practice the metal was hot in that sense. The question of camber was, he admitted, rather difficult. He had often wondered how it was that he received a pattern, and he made it according to his system—that is, he did not put in any cinder bed under the mould or camber on the pattern—yet the job came out straight and without scab. Other founders had both these difficulties, even when using a cinder bed. When there was a matter of 20 tons of molten metal on the floor of the mould, pressing on to a cinder bed, one had from one angle the base of the casting resting on the cinder bed, but there was no such contact with the method outlined. That was the only explanation available. But the lecturer was open to further enlightenment if possible. In answer to the question as to sand mixing, Mr. Flower said he did not take any special provision as to mixing his facing sand. It was simply 50 per cent. new and 50 per cent. old sand. There was no extraneous matter. If one added anything else, one was liable to include combustible material, which evolved gas.

In answer to the Chairman, who asked whether Mr. Flower's sand was facing sand or in the open state, Mr. Flower said he certainly milled it to get the increased bond. In answer to another question, he said he did not run it up hill at all; it was perfectly level.

Splashing.

Mr. Fearnsides (Keighley) spoke of his firm making castings 20 ft. long by 4 ft. wide in green sand without a vent near them—a statement which caused Mr. Flower to express surprise, but which Mr. Fearnsides said could be verified at any time. In regard to one type of dry-sand mould, Mr. Fearnsides suggested that if one were not careful one was liable to get a splash back into the face which was dangerous and might burn somebody badly. That seemed liable to occur when the metal was being poured in, out of the shank; when it got to the bottom of the mould it was liable to come back up the runner. It would be interesting if anybody could say why and how that occurred. Personally, he thought it might be due to the heat of the mould, through not allowing it to become reasonably cold.

The Chairman said he thought the occurrence mentioned by Mr. Fearnsides was surely unusual rather than common. It was something which he had not experienced, and if he did experience it he would certainly want to look into the matter. Had Mr. Fearnsides coal dust in the face when this happened?

Mr. Fearnsides: No; horse manure and carrying a coat of blacking. The moulds were perfectly dry.

The Chairman said he thought this was a phenomenon which it would be of general interest to examine at the next open meeting of the Branch for dealing with members' general foundry problems.

Eliminating Coke Beds.

Mr. S. W. Wise (hon. sec.) said he thought Mr. Fearnsides' problem must be due to gas accumulated in the mould and momentarily unable to escape. Mr. Flower's theme was a very interesting one, but, personally, he thought the coke bed dealt equally with the problem of moisture in the sand. He (Mr. Wise) recollected a time when he took charge at a foundry where he was told they were considerably troubled with water. They had a pump in the yard and had to keep a well at a certain level. On a very wet week-end the water from the well overflowed, and when they went on the Monday to cast a 3-ton casting, the place was so swilling with water that they could not get near it. They emptied the well, and it turned out to be part of a chamber leading to an old gas-producer; there were pipes led under the whole length of the foundry, which had formerly been a glassworks. It was found that a coke bed in that foundry floor was the salvation of many jobs in hand as an insulating point for the water which they had not known was in the floor. Personally, Mr. Wise believed a coke bed served a very good purpose in that direction. The meeting, he was sure, had been very much impressed and interested by Mr. Flower's description of his method of eliminating coke beds, but he (Mr. Wise) would prefer to try it out on a small job before a large one.

The Cinder Bed a Gas Producer.

Mr. Flower asked whether a cinder bed functioned in any way other than to take away the gases. He insisted that it did and that it acted as a kind of gas producer itself and through its use one was actually producing gas, to the inconvenience of everybody working in the shop. If there were no cinder bed under one could not possibly produce gas, because there was nothing to produce gas from. One had nothing but the sand bed of the mould—silica—with open spaces between the particles which were sufficient to cope with any little gas that might possibly be generated. He hoped some would try this method, if only on some small jobs.

Mr. H. Holdsworth (Bradford) said he recollected that at the January meeting of the Branch they discussed casting a planing machine bed of rather large dimensions, and on the subject of drying Mr. W. Parker spoke of moulds dried by a portable drier in five hours. He had a suitable coke bed underneath, with an adequate outlet for air. In that discussion Mr. Parker had rather emphasised the value of a coke bed being underneath a large casting of that description.

Coke Beds said to cause Water Collection.

Mr. Flower said he maintained that it was impossible to dry perfectly a bed with a cinder bed under it in the ordinary time generally allowed to the foundryman. He would suggest that those interested should try an experiment some morning during the following week. Let them continue their coke bed for three feet or so beyond the length strictly required for the job. One hour before they were going to cast, with everything ready, dig down on this extra piece to the coke bed itself, and he (Mr. Flower) would be prepared to guarantee that they would find a sump of water there. If there was water down there outside of the casting, they could be quite certain there was similar water actually underneath the mould. It was there because hot, damp air was drawn down from the casting, and, on getting into contact with the cinders, it immediately condensed into water, and a quantity collected beneath the cinders. Above it, and under the mould, would be a hot dry surface. The job might be allowed to dry for two or three days, but these dryings would automatically draw the dampness back along the bed. He maintained that it was better to test the drying of six inches of solid sand than six inches of sand and cinders.

Mr. Holdsworth asked where the moisture went with Mr. Flower's method. Was it driven down? If, on the other hand, it drew up, was it not just as likely to draw up with a coke bed as with an all-sand bed? If in the sand bed it did not draw up and it did not draw down, where did it go? Mr. Flower said, with a coke bed the moisture is drawn down. Is it not just as likely to go down into the solid sand?

Mr. Flower described the crux of the situation as a visualisation of the action of the heat on the bottom of the mould. Everything, including steam and hot air, takes the line of least resistance, which is in this case down the channels which have been placed for their convenience. One cannot drive down the humidity where a coke bed has been eliminated, because there is nowhere to drive it to, so automatically it has to force its way upwards, because that is the line of least resistance. With a coke bed the line of least resistance is downwards into the coke, where the steam condenses into water.

Nature of Sand Job and Venting.

Mr. J. J. Watson (Huddersfield) said he could not quite agree with Mr. Flower's description of the dry sand as practically nothing but silica. If that was so in Manchester, they were in a happier position than in West Yorkshire. Most of the sand in the West Yorkshire area had a good deal of organic matter in it, which produced gas.

Mr. Flower said that most of the organic matter was burnt out in drying, and what little was left was so small that the pores of the sand would accommodate what gas may be generated.

Mr. Watson asked if Mr. Flower would use vents for dry-sand moulding in boxes. Personally, Mr. Watson would prefer it to ensure quicker drying.

Mr. Flower agreed, but doubted its efficacy for carrying gas away. Often, he said, if one inserted a vent for such a purpose, it was liable to generate gas, because one introduced air in the vents, and therefore created gas.

Unvented Green-Sand Moulds.

The Chairman, referring again to Mr. Fearnsides' remarks as to casting his jobs in green sand without vent, said it was almost difficult to credit what a difference it made when a job was cast on the cant where the metal climbed. But when Mr. Fearnsides referred to casting 20-ft. beds without a vent, he certainly had thrown a bomb amongst them that evening.

Vote of Thanks.

Mr. Fearnsides, moving a vote of thanks to the lecturer, said Mr. Flower had almost opened up a hornet's nest in his lecture. He was, however, trying to eliminate hard work in the

(*Concluded on page* 174.)

Some Notes on Gating.

By Thomas Davis.

The gate or runner of a casting is the means whereby metal is conveyed from the ladle to the mould, the application of this principle varying according to the size and shape of the casting. A very important point to bear in mind when arranging the gate, especially for large castings, is to allow the metal to enter the mould with as little hindrance as possible. As there are different sizes and shapes of castings, it follows that we require different kinds of gates.

The following are a few of the various types most generally used:—(1) Drop-gates, that is when the metal is dropped through the top part

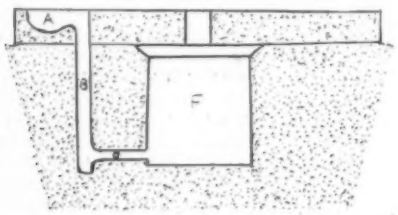

Fig. 1.—Showing Mould ready for Casting.

direct into the mould; (2) cut in at the joint; (3) part way between the joint and bottom of the mould; and (4) at the bottom of the mould. There is also the horn-gate, which is used with great advantage in making small-teeth wheels, as it allows the metal to enter the mould without disturbing the teeth.

Gating a Machine-Tool Mould.

As an example, it is proposed first to consider the gating of a large casting, made either in dry or green sand, for machine-tool work, which requires a clean, sound casting. Fig. 1 shows a mould assembled and ready for casting, and it will be noticed that the metal, after leaving the runner head A, flows into the down-gate B and through the inlet C direct into the mould F. This is a typical example of the general practice when arranging the gate of such a casting, and is at fault because no preparation is made for preventing the dirt passing into the mould. Fig. 2 shows a similar mould

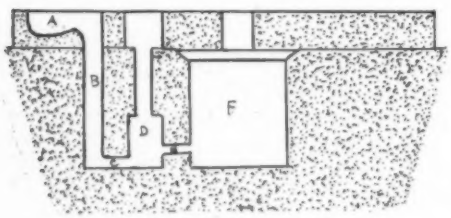

Fig. 2.—Showing Improved Gate Arrangement.

arrangement with a better method of gating, since any dirt or slag finding its way into the down-gate B is held securely in the dirt-riser D, whilst the clean metal flows through the inlet E into the mould F. In order to obtain the best results from this form of gate, due attention must be paid to several essential features. The down-gate B must be larger in diameter than the dirt-riser D, and the inlet C leading to the dirt-riser D must be approximately twice the size of the inlet E, and must enter D at an angle, thus giving the metal a whirling motion (see Fig. 4).

The result of this will be that the down-gate B and the inlet C will be able to supply more metal than is required to "feed" the inlet E, and consequently the whirling metal in the dirt-riser D will flow up into the riser head G, bringing the dirt, scum and slag with it. In order to simplify what might appear to be—and in some cases is—a complicated matter, the lower part of the dirt-riser D, and the two inlets C and E, are made of strong oil-sand cores. Fig. 5 shows the oil-sand core and gate-pin required to form the dirt-riser D. This can be applied in two ways:—(1) The inside diameter of the core can be made the same size as the gate-pin, thus giving a dirt-riser the same size from the bottom to the riser head; (2) the core can be made 2 in. (or more)

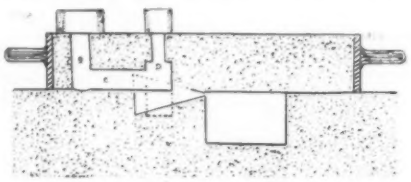

Fig. 3.—Gate Arrangement for Smaller Castings.

larger than the gate-pin, and covered with a flat core, in the centre of which is a hole the same diameter as the gate-pin. This will form a small reservoir of whirling metal at the base of the dirt-riser, and is to be preferred when dealing with large castings.

Gating Smaller Moulds.

A modification of this principle can be applied to medium and smaller castings. When the joint has been made and the top part placed in position, a round wooden plug, varying according to the size of the casting, is placed about an inch from the edge of the pattern. A gate-pin is placed on the top of this plug, and another one about 2 in. from it completes the requirements. When the top part has been lifted off and turned over, a channel is cut from the down-gate B into the recess formed by the wood plug, and the gate leading into the mould is cut in the bottom part, as indicated in Fig. 4. It will be noticed that the channel C in Fig. 4 is led to the side of D, thus giving the metal—in a modified form—a whirling motion, similar to that described for large castings.

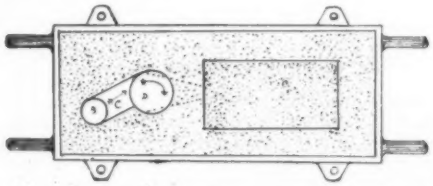

Fig. 4.—Channel cut in the Top Part, the Dotted Lines indicating the Gate.

A still further modification can be applied to small moulds made in hand boxes. Where several patterns are being moulded in one box, it is advisable to try to arrange these so as to allow a straight channel to be cut, thus ensuring that all the in-gates will receive sufficient metal to keep them full during casting. The dirt channel is cut in the top part from the down-gate B, and should extend several inches beyond the last mould. The in-gates are cut in the bottom part, care being taken to see that they extend sufficiently far to come under the dirt channel in the top part (Fig. 6).

The basic principle underlying the dirt-riser idea is that dirt, scum, slag, etc., being lighter than iron, will float to the highest point that it can reach. From this premise we continue our reasoning thus: If preparation is made to allow the dirt and scum to float above the in-gate, there is less likelihood of it entering the mould, and more prospect of a clean, sound casting.

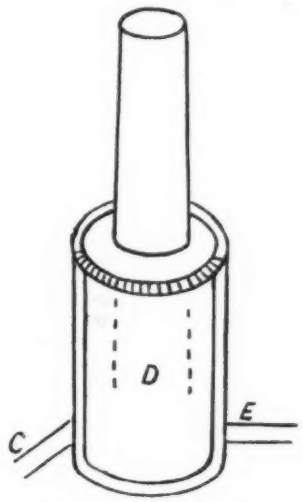

Fig. 5.—Oil-Sand Core and Gate-Pin.

When a casting requires to be machined it is a sound policy to spend at least a few minutes considering the form and location of the gate. It may mean all the difference between a good casting and a bad one.

The dirt-riser described is simple and practical. If the particulars outlined are applied

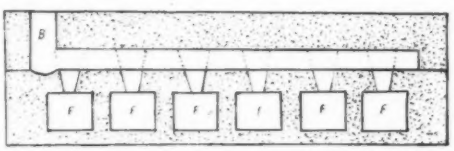

Fig. 6.—Dirt Channel for Hand Boxes. The Dotted Lines indicate the Gates in the Bottom Part.

in an intelligent manner the result will be a considerable reduction of castings scrapped through dirt and scum passing into the mould at the time of casting.

The Venting of Dry-Sand Moulds.

(*Concluded from page* 173.)

foundry, and in that respect they were all in agreement with him. Venting was one of the hardest jobs, and in all foundries there had been vast waste of effort from venting. Mr. Flower had got on to the right track in finding means to do away with it, especially on big jobs. He (Mr. Fearnsides) entirely agreed with his principle of doing it with dry-sand moulds, though evidently the results with green sand which had been mentioned had been somewhat of a surprise to Mr. Flower, as to others present.

The vote of thanks was seconded by Mr. W. Hawley (Brighouse) and carried unanimously.

The buildings and plant of Messrs. Pollit & Wigzell, Limited, engineers and ironfounders, of Bank Foundry, Sowerby Bridge, Yorkshire (in voluntary liquidation) are to be sold by auction on the site on March 10 and 11.

XUM

Some New Views on Smelting and Remelting Processes.*

By J. E. Fletcher, M.I.Mech.E.†

In his recent informative presidential address to the Staffordshire Iron and Steel Institute, Mr. Hoskisson drew attention to the manufacture of foundry pig-iron in the Midlands, specially remarking upon the factors which at the present time are contributing to such a high cost of production as to make slowly-smelted iron almost unsaleable, except in the case of a few blast-furnace plants producing pig-iron of cold-blast type. The author is still old-fashioned enough to believe that pig-iron of high quality, produced in slowly-driven furnaces using cool blast, should be recognised as essential to the well-being of a nationally and internationally valuable industry—the basis of those processes which have for so many years given high-class British cast iron and wrought iron a renown which has not been seriously disputed.

The modern group of worshippers at the shrine of mass production and low costs may have ignored the fact that with the growing demand for high-speed machinery in every direction there should be an increasing desire to respect the "safety first" needs of the community. There are those who, obsessed by the modern gospel of rationalisation, look forward to the time when the only blast-furnace plants which will hold the British field will be of the intensively-driven type—a dozen plants of the thousand-ton-per-day type, highly mechanised and requiring next to no labour to operate, being sufficient for British needs! Thirty-six furnaces of this type could produce 12 million tons of pig-iron per annum, and it requires but little imagination to see that the location of these furnaces would have to be so chosen as to meet the needs of home and export trade.

It may be, however, that British experience will prove that the thousand-ton-per-day blast furnace is too large. The Dagenham furnace of the Ford Company, having an output of 500 tons per day, may prove to be satisfactorily economical for dealing with leaner ores of phosphoric type, but even with such furnaces one can visualise British needs being met by less than one hundred furnaces, should it prove possible to produce iron of sufficiently good quality for foundry work, wrought-iron manufacture and for the needs of the special steel trade. In 1913 ten million tons of pig-iron were produced in 487 blast furnaces in the United Kingdom, the average production per furnace being at the rate of about 400 tons per week.

Mr. Francis Samuelson, in his presidential address before the Iron and Steel Institute in 1922, computed that 388 blast furnaces were sufficiently equipped to produce 264,000 tons weekly—an average per furnace of about 680 tons per week. Actually the 388 furnaces produced 10¼ million tons in 1913, the average production of pig-iron per furnace weekly being about 500 tons, or 73.5 per cent. of their capacity. Owing to the rapidly-growing demand for basic iron for steel production it may be expected that the location of the high-output blast furnaces will be in close proximity to the Midlands belt of phosphoric ores which run from Oxfordshire to North Lincolnshire, conveniently situated for coke supplies, railway facilities for cheap distribution, and not too far removed from the seaboard. So long as the Cleveland ores are commercially available high-output blast furnaces may be operated near the North-East Coast, but, if the lean ores from the Midlands belt have to be increasingly used as the Cleveland ore supply shrinks, there may be a return to hematite working on a large scale in the North-Eastern area, foreign ores being easily shipped to the Tyne and Tees.

South Wales and West Cumberland may be expected to continue the making of hematite iron in high-output furnaces, but if the demand for hematite pig-iron shrinks to between 20 and 30 per cent. of the total national requirements, two high-output blast furnaces in each of the hematite areas (West Cumberland, North-East Coast, South Wales and Scotland) would meet the supply. The availability of good furnace coke in the Northern and South Wales areas must influence the future of hematite pig-iron production in these areas, and high-output furnaces there would seem to be desirable from a national standpoint. It would, however, seem inevitable that the major portion of the future needs of the iron and steel industries will be largely met by the phosphoric pig-iron supplied by high-output furnaces in the neighbourhood of the Midlands-to-Lincolnshire basic-ore beds.

Whilst admitting that the needs of the steel industry will be met by cheap basic and hematite pig-iron, the requirements of the iron foundry and wrought-iron industry cannot be met by rapidly-smelted highly-phosphoric and hematite irons. It is becoming increasingly evident that higher quality in iron castings and in wrought iron will be demanded in the future and this higher quality may not be guaranteed by synthetic metal produced from mixtures of high- and low-phosphorus content pig-irons and steel scrap. The resulting product of such cupola-melted mixtures is not the same as the metal produced from remelted cast iron of similar chemical analysis—the yield of slowly-smelted "all-mine" burdens in small blast furnaces.

"Kishy" Irons.

The bane of all rapidly-smelted foundry pig-irons is the high total-carbon content, "kishy" metal being an enemy to high quality and homogeneity in the structure of the remelted metal. Both American and German foundry practice is suffering from the use of "kishy" irons, and, notwithstanding the many theoretically-sound attempts to neutralise the defect of high total-carbon content in cheap foundry pig-irons, the results are not sufficiently uniform to satisfy the more rigid specifications of engineers for iron castings and genuine wrought iron. In the case of iron castings, higher tensile and transverse strength is being demanded, and this can often be readily obtained in cast test-bars, but not from the castings unless the location in the casting is chosen where soundness and a close-grained structure may be expected.

Steel-Mix Cast Irons.

It is well known that the presence of steel in cast-iron mixtures, within certain limits, gives metal of greater tensile and transverse strength and hardness. Cast iron, however, is a relatively brittle material, possessing very little ductility. A steel-mixture iron may on analysis give a combined-carbon content corresponding to that of pearlite, which constituent may, as in a steel, be either brittle or tough according to the rapidity of the cooling action, and to the later heat-treatment. Moreover, the chemical analysis is only representative of the mean composition of the drillings taken. A 0.8 per cent. combined-carbon determination may be the mean of 1.2 per cent. and 0.4 per cent. (a mixture of hard and soft metal).

It has to be remembered that, at the moment of freezing, the whole of the carbon, as a rule, is in the combined state. The metal during cooling passes through a series of conditions which can be illustrated by quenching the iron at the solidification point and at successively lower temperatures. Steel-mixture irons so examined often show irregular areas of hard cementite and pearlite or mixtures of the intermediate constituents. One is forced to conclude that this heterogeneity may, as often as not, persist during the normal cooling of a casting in the mould. High-carbon "steeliness" in cast iron, even in microscopic variations within a small area, is often associated with hardness and brittleness.

"Steeliness" in Cast Iron.

If the degree of such "steeliness" varies from point to point, irregularly, and is affected by interfering flakes of graphite, brittleness and lack of strength uniformity may be expected. The occasional demand for high-tensile cast iron exceeding, say, 14 tons per sq. in., cannot easily be met without the use of steel or other alloys in the cupola mixture. The metal is liable to brittleness in proportion to the hardness value and to the degree of uniformity in the distribution of the "steely" areas in the metal structure. The author has raised this point because not infrequently he has found the use of mixtures containing steel scrap and high-phosphoric pig-iron as a means for securing high tensile strength and increased hardness. The large percentage of casting troubles examined by the author during a long experience has been traced to unsatisfactory mixtures, the most glaring defects being found in so-called "semi-steel" castings.

Value of All-Mine Pig Insufficiently Recognised.

The ridiculously low prices quoted for iron castings of important character and which demand the use of first-class pig-iron is evidence that low-quality pig-iron, strengthened, as supposed, by steel additions to the cupola mixtures, have been used in many cases. The author holds no brief for any brand of foundry iron, but he would unhesitatingly affirm that a greater appreciation of the value of "all-mine" pig-irons as the basis of cupola mixtures is long overdue. The skin zone of an iron casting is of vital importance, and it requires but little argument to prove that metal of homogeneous structure in the molten condition is less likely to freeze irregularly at the skin of a casting than when the metal is a confused mixture of "steely" (high-contraction type) metal and highly-siliceous (low-contraction type) iron. A remarkable commentary on the value of "all-mine" cold-blast iron is the fact that the analysis deemed the most satisfactory for high-class castings approximates closely to that of good cold-blast iron containing between 1.2 and 1.5 silicon, 0.6 manganese, 0.5 to 0.6 phosphorus, and 3.0 to 3.3 per cent. total carbon.

Ductility of Cold-Blast Iron.

A steam rolling-engine beam casting made by the Coalbrookdale Company in 1813 was broken up in the author's presence some time ago. The beam was definitely bent during the endeavours to break it by a heavy falling ball. The analysis of the iron beam was almost exactly that of the cold-blast iron given above (3.2 T.C., 1.3 Si, 0.6 Mn, 0.6 per cent. P). Another casting from an old blowing engine which worked for over 80 years in a Black Country blast-furnace plant showed similar ductility when broken up. Motor-car cylinders cast from remelted Coalbrookdale cold-blast iron scrap have given exceptionally satisfactory results, the metal being grey in thin sections whilst containing little over 1.0 per cent. silicon.

In the early days of gas-making, retorts of cold-blast mottled iron were used in the Black Country and gave "long-life" evidence of their heat-resisting value. This has also been proved in the case of air-heating pipes for blast-furnace stoves in old Black Country plants.

The above illustrations have been given for the purpose of drawing attention to the fact that synthetic mixtures of white and grey hot-blast irons to which steel additions have been made to reduce the total-carbon content, the remelted metal giving a chemical analysis similar to that of cold-blast iron, produced cast iron of high

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* A Paper presented before the Staffordshire Iron and Steel Institute and the Sheffield Section of the Institute of British Foundrymen.

† The author is Past-President of the Staffordshire Iron and Steel Institute and consultant to the British Cast Iron Research Association.

combined-carbon content and were of mottled or white fracture, whilst the remelted cold-blast iron, when cast into similar moulds at similar pouring temperatures, was machinable and had a grey fracture, the microstructure being of homogeneous and dominantly pearlitic character. The characteristics of pig-iron must be traced back to the blast furnace, where the ore is first reduced to pure metallic iron grains which, as they descend through the furnace shaft, become carburised.

Technique of Carburisation.

The degree of carburisation depends upon the time taken by the sponge iron to reach the melting zone, the temperature of the reducing and carburising gases, the porosity and permeability of the burden column, the relative volumes of coke, flux, ore, gangue, and of the spongy iron mass. With a given burden the velocity and temperature of the ascending, reducing and carburising gases are dominantly important factors in the carburisation of the sponge iron in a blast furnace of known proportions working under conditions of regular blast supply and uniformly regular charging. Any serious irregularity in any one of the above factors must disturb the degree of carburisation in the sponge iron and lead to lack of uniformity in the resultant pig-iron.

If the blast temperature is continuously low and the rate of blast supply uniformly regular, the gases rising from the hearth are, when the blast supply is at the practicable minimum, of low velocity and comparatively low temperature. Such are the conditions prevailing in small cold-blast furnaces.

In a Swedish charcoal cold-blast furnace using rich ores, the descending sponge iron has the advantage of an efficient carburising medium in the form of charcoal, as well as the ascending streams of CO gas. The sponge iron, therefore, arrives at the hearth fully carburised to the eutectic condition (containing about 4.3 per cent. carbon).

In an English cold-blast furnace, working on leaner ores and coke charges, the gases come into contact with fewer grains of sponge iron, much of the gas passing to the furnace top without coming into contact with sponge iron. Much of the heat in the gases is given to the ore gangue and the sponge iron descending to the hearth is less highly carburised. The molten iron is therefore hypo-eutectic (contains less than 4.3 per cent. carbon).

A New View of the Alloying Actions in the Blast-Furnace Hearth.

The author has long held the view that the liquid carburised sponge iron is alloyed with silicon, manganese and phosphorus in the furnace hearth, whilst in contact with the slags which primarily contain the gangue metallic oxides SiO_2, MnO and P_2O_5. The Si, Mn and P are obviously reduced from the slag by reactions between the oxygen of the Si, Mn and P oxides and carbon. Recently the necessity for the intimacy of the reactions between the oxides and carbon was brought home to the author whilst conducting trials in furnaces employed in producing sponge iron and cast iron from finely-divided ores by gaseous reaction without coke.

The sponge iron before melting was found to be of eutectic composition when the furnace atmosphere was richly reducing in character and of sufficiently high temperature. With lower temperatures the sponge iron was lower in carbon (hypo-eutectic) and with very high temperatures the iron was hyper-eutectic (higher than 4.3 per cent. carbon content). When the liquid sponge iron was allowed to flow into a hot slag of suitable analysis, no carburising gases being in contact with the slag, the usual alloying actions took place, the carburised iron supplying the necessary carbon for the alloying reactions.

From this experience the author concluded that the molten sponge iron flowing through the slag in the blast-furnace hearth provided the carbon necessary for the intimate alloying reactions whereby silicon, manganese and phosphorus enter the molten iron. By considering the carbon required for the alloying of the iron to be taken from the eutectic portion of the carburised sponge iron it became evident that the final alloyed product was a mixture of the remaining portions of the eutectic (after sufficient carbon had been extracted for the alloying reactions) and an alloyed portion consisting of iron, silicon, manganese and phosphorus. The iron in this alloyed portion then takes up new carbon from the coke and CO gas in the hearth to an extent depending upon the temperature of the hearth and upon the composition of the alloyed portion.

As an illustration of the method used for the determination of the two constituents in a pig-iron of known analysis, the case of a Staffordshire cold-blast iron will be taken. Its composition is:—T.C., 3.10; Si, 1.35; Mn, 0.75; S, 0.04; P, 0.57; and Fe, 94.19 per cent. The estimated eutectic of 4.3 per cent. carbon content in the carburised sponge iron before alloying with Si, Mn and P in the blast-furnace hearth is Fe 94.19 + (C 4.3 × 0.9419) = 98.24.

The 94.19 lbs. of Fe in the pig-iron are estimated to have taken up 4.05 lbs. carbon to form 98.24 lbs. eutectic.

Alloying with Silicon.

The reaction between the SiO_2 in the slag and carbon in the carburised (eutectic) sponge iron is:—

$SiO_2 + 2C = Si + 2CO$.

28 lbs. Si require 24 lbs. C.

1 lb. Si requires 0.857 lb. C.

The weight of eutectic (4.3 per cent. C) containing 0.857 lb. C is 19.9 lbs.

The weight of eutectic required to alloy the iron with 1.35 lbs. Si is 1.35 × 19.9 = 26.9 lbs.

In the reaction 1.35 × 0.857 = 1.16 lbs. carbon is liberated in the CO gas and, if the silicide Fe_2Si (FeSi+Fe) is formed (which corresponds closely with Wüst and Peterson's research results) the weight of Fe_2Si formed is 1.35 × 5 = 6.75 lbs., leaving 18.99 lbs. of free Fe.

Alloying with Manganese.

The reaction between the MnO in the slag and carbon in the carburised (eutectic) sponge iron is:—

$MnO + C = Mn + CO$.

55 lbs. Mn require 12 lbs. C.

1 lb. Mn requires 0.218 lb. C.

The Mn is alloyed with C to form Mn_3C and with S to form MnS; the MnS formed is 2.72 × 0.04 = 0.11 lb. requiring 0.07 lb. Mn. This leaves 0.75 − 0.07 = 0.68 lb. Mn to form Mn_3C.

The reaction involved in forming Mn_3C is:—

$3MnO+4C=Mn_3C+3CO$.

165 lbs. Mn require 48 lbs. C.

1 lb. Mn requires 48/165=0.291 lb. C.

The weight of eutectic (4.3 per cent. C) containing 0.291 lb. C is 6.76 lbs. In the reaction 0.73 lb. Mn_3C is formed, the 0.68 lb. Mn requiring 0.68 × 6.76 = 4.6 lbs. eutectic. The products of the reactions are the following:—Mn_3C, 0.73 lb.; MnS, 0.11 lb.; free Fe, 4.45 lbs.; and CO gas, 0.35 lb.

Alloying with Phosphorus.

The reaction between the P_2O_5 in the slag and carbon in the carburised (eutectic) sponge iron is as shown below:—

$P_2O_5 + 5C = P_2 + 5CO$.

62 lbs. P require 60 lbs. C.

1 lb. P requires 0.969 lb. C.

The weight of eutectic (4.3 per cent. C) containing 0.969 C is 22.5 lbs.

The weight of eutectic required to alloy the iron with 0.57 lb. P is 0.57 × 22.5 = 12.8 lbs.

The products of the reactions are as under:—

Fe = 12.30 lbs. or Fe = 9.21 lbs.
P = 0.57 lb. or Fe_3P= 3.66 lbs.
CO= 1.18 lbs. or CO = 1.18 lbs.

(To be continued.)

An American Symposium on Malleable Cast Iron.

One of the features of the 1931 annual meeting of the American Society for Testing Material, in June, will be a symposium on malleable-iron castings, the purpose of which will be to put before engineers in a concise form authoritative and critical data on the properties of malleable castings. This symposium is sponsored jointly by the American Foundrymen's Association and the A.S.T.M. In addition to the submission of data there will be discussions of properties that may not at present be capable of completely authoritative treatment, but which may have significant bearing upon engineering applications of the product.

The symposium will be divided into two parts, the first part being the submission of data on the properties of malleable-iron castings and the second part the presentation of separate Papers.

Data on Properties of Castings.

Tabular and graphical presentations of data on the following properties are contemplated:—

A—*Physical Constants.*—Density, coefficient of expansion, and specific heat.

B—*Mechanical Properties.*—Tensile strength; yield point; elongation; reduction of area; modulus of elasticity in tension; compressive strength; yield point in compression; modulus of elasticity in compression; shearing strength; transverse strength (modulus of rupture and maximum deflection); torsional properties; Charpy impact value; wedge test; Brinell hardness, and endurance fatigue limit.

C—*Electrical and Magnetic Properties.*—Resistivity and permeability.

D—*Microstructure.*

E—*Machinability.*

F—*Heat-Treatment Effect.*

Presentation of Papers.

Papers on the following subjects are in prospect:—

Relation between tensile strength and elongation of malleable iron.

Corrosion-resistant properties of malleable iron.

Resistance to embrittlement of malleable iron by galvanising, and its relation to tensile strength.

Relation of test-bars to properties of castings.

At the 1931 annual meeting, which will be held in Chicago from June 22 to 26, at least two of the sessions will be joint sessions with the American Society of Mechanical Engineers in sponsoring a Symposium on Effect of Temperature on the Properties of Metals, arranged under the auspices of the Joint Research Committee of the A.S.T.M. and A.S.M.E. on Effect of Temperature on the Properties of Metals. It is also planned to hold a joint session with the Western Society of Engineers with a programme devoted to the discussion of the significance of specifications in certain major industries of the Chicago district.

The Report of the Sheffield Industrial Mission to South America has been issued by the Department of Overseas Trade and published as a White Paper by H.M. Stationery Office (price 1s. 3d.). Among the recommendations of the Mission are:—That a special South American Section should be formed of the Sheffield Chamber of Commerce, that a special Sheffield Trade Commissioner should be appointed to follow up the work of the Mission, that non-competing firms should group together for the purpose of forming selling organisations, and that principals and managing directors should visit the market much more frequently and stay longer.

Foundry Costing.

At a meeting of the Scottish Branch of the Institute of British Foundrymen, held in the Royal Technical College, Glasgow, on February 7, MR. A. F. PATERSON presented a Paper on "Costing." Mr. James Miller (Branch-President) presided, and, in introducing the lecturer, said that the subject upon which Mr. Paterson was to speak was one in which he was afraid that the average foundrymen took little or no interest. That, he thought, was a mistake, as it was important that the foundryman should know in at least a general way the cost of the work he turned out. The more they knew of the cost and the manner of determining it, the better the position they would be in to make a good casting at a correct price. Mr. Paterson then read his Paper, an abstract of which is printed below.

Reduction of Costs.

At the outset, he said that much time and energy had been devoted by engineers towards obtaining the maximum production from their workers, their machinery and tools, and the materials from which their maunfactures were produced, and that engineers had been greatly assisted in this by the introduction of more scientific costing methods.

In referring to cost reduction, he said that to the worker this meant making him produce more in a given time for the same money; to the foreman it meant not only the reduction of direct labour on a given job, but also the necessity of planning ahead and maintaining the operative equipment and facilities in first-class order, also the reduction of defects and the control of indirect expenses and power. The manager viewed cost reduction as including all these things, and, in addition, that the stock of materials, manufactured parts, and work in progress did not become excessive; also, that the highest efficiency was exercised in purchasing and in checking receipts of goods both as regards quantity and quality, and also in the control of plant investment and the regulating of administrative expenses.

There was one man whose study of costs was essential if the best article was to be turned out at the lowest price, but either through lack of interest or lack of opportunity he saw practically nothing of them—he was the draughtsman, the designer. Technical schools taught draughtsmen to be conversant with strains, stresses and strengths of materials and design, but very little attention was directed to costs. If there was anyone who had it in his power to make a job dear or cheap it was the designer. Mr. Paterson also referred to the effect of the selling policy on production, as to whether a foundry was to make to customer's design or adhere to a standard design only.

Costing Essential.

Some method of costing was essential to the profitable management of any foundry, and whilst costing was not exactly a simple matter, it was not so mysterious that every foundryman could not understand it. The lecturer emphasised that the man who did not know the cost of the various articles made by him was a menace to the industry. Competitive conditions were seriously disturbed where losses on one or more kinds of work were recovered from profits on other kinds of work. Was it fair competition, he asked, to be obliged to meet a price that was based upon a guess and might be less than the actual cost of manufacture?

Whilst the foundryman admitted that the adoption of more modern technical and physical methods had an advantage, he was extremely slow to admit that a foundry might benefit by modern office and business methods. It was due to the lack of costing that there was such a small margin of profit in the industry at the present time. Ignorance of actual costs caused the manufacturer to make unprofitable prices which the manufacturer who did know his costs was forced to meet.

It was not his intention, said Mr. Paterson, to explain a costing system in detail. When tackling a complete system, one should read it, and even for one well versed in costing systems it was a severe tax on one's memory and imagination to follow a lecturer on such a comprehensive subject. He proposed to refer to a few points regarding costs, with a view to stimulating interest, and for those who had no experience to encourage them to study some of the systems published in THE FOUNDRY TRADE JOURNAL during recent years.

There were right and wrong ways to costs. Most errors in foundry costing came from using methods which did not truly reflect the amount of work, material, and usage of equipment properly chargeable to different types of castings. A good cost system should give accurate figures, and to do this it had to be designed to take into consideration the manufacturing problems. No amount of good accounting could make up for a badly-arranged apportionment of costs.

Principle of Cost Finding.

The lecturer referred to numerous methods used at present, and suggested that the Scottish Branch should take the initiative in installing a standard system. The principle of cost finding was the same for all foundries, although each foundry might differ in its detail. Properly-designed cost methods could be used as a guide to shop efficiency, as a guide to designing departments, and as a guide to installing new equipment and to set selling prices. The final manufacturing cost of an article was made up of the cost of materials, labour and overhead. There were direct materials and indirect materials. Direct materials were those materials which entered into the product and could be identified in the finished article. These included pig-iron, scrap, etc. Indirect materials consisted of materials which aided in the manufacture but could not be directly charged to the finished article, such as fuel, sand and oil. Secondly, labour was divided into direct labour and indirect labour. Direct labour, sometimes termed "productive labour," was that labour applied to a casting which could be directly charged to that casting, *i.e.*, moulders and coremakers. Indirect labour was that labour which was necessary to the production of the casting, but which bore no directly ascertainable ratio to the cost of the casting, as cupola men, sand mixers, etc.

Overhead Charges.

Lastly, there was overhead, which consisted of indirect expenses, administrative expenses and selling expenses. Indirect expenses were those expenses incurred in running a foundry which could not be charged to any particular casting but could only be apportioned over all the castings produced. These expenses included power, light, rent, rates, machinery repairs, machinery depreciation, etc. Administrative expenses included only those items of expenditure which did not directly enter into the cost of manufacture but which were incurred in the general administration and included such items as estimating, auditors, legal expenses and management, etc. It was not good practice to charge to overhead items which could be charged direct; as little as possible should be charged to overhead, for ultimately all expenses had to be spread over the product. This could, of course, be overdone.

Overhead, the lecturer explained, was a service charge and each casting had to pay for the facilities provided. A heavy, compact, simple casting would carry only a small proportion of the moulding expenses, whilst it would take a larger share of the melting expenses. A large and light casting would take more of the moulding expenses and less of the melting expenses.

To allocate these expenses correctly, the lecturer stated that the foundry should be divided into departments such as melting, core-room, heavy floor moulding, light floor moulding, bench moulding, machine moulding, dressing, pattern shop, machine shop, power and light, tools and maintenance. Expenses for each of these departments should be collected together and a measure determined by which they could be charged to the different castings. Melting would be per ton; moulding per hour, or allocated over direct wages. Machine rates might be fixed for machine moulding. The test for a department was—Could the overhead expense of all operations in this department be justly applied on the same basis? If not, further subdivision was necessary.

The departments and methods of allocating expenses could only be determined after a thorough investigation had been made by men familiar with foundry practice and cost-finding principles. The methods to be used had to fit the manufacturing conditions of the individual foundry and the accounts in the general books set up accordingly.

DISCUSSION.

The BRANCH-PRESIDENT said that they had listened to a very interesting Paper given by one who thoroughly understood the subject. It was possible that some of them expected something very much more academic, but they had had the subject put in such a way that the average foundryman could follow it without difficulty. The foundry was looked on by some people as simply a place for producing a casting, but it would be seen that it was really something much more than that. He thought it doubtful whether the employers would ever agree to a standard system of costing; very probably they would say let well alone. Mr. Paterson had explained a system of getting out the cost in language which they could all understand, and although they might not be able to offer much criticism, there might be some points upon which they desired further information, and Mr. Paterson would be very pleased to answer any questions.

Dividing the Costs.

MR. JAMES AFFLECK said he had found that accountants' statements did not always tell the truth, at least from the foundry point of view. It was really essential that there should be some proper method of building up the cost accounts; there were so many people who did not know the real cost of the castings they produced, with the result that they quoted ridiculous prices, and sometimes the man best able to do the work did not get the job. It was true that the incidence of design influenced the price to a considerable extent, and the draughtsman influenced the cost considerably, but he thought it was asking a lot of him to carry out the elements of engineering design and then to modify them so as to accommodate the foundry. His experience was that very few moulders could read a drawing, so that it was necessary to refer to the draughtsman for an explanation. The draughtsman had to work hard to qualify for his job, he served five years' apprenticeship and had to study at classes and did not, as a rule, receive much salary. The system of departmentalising advised by Mr. Paterson was good, but the division of the cost presented some objections. It could be overdone; he had seen a system where there were about 40 divisions of cost items. It was so cumbersome that the firm eventually found out that their business was to make castings and not cost sheets.

An Example of Inaccurate Estimating.

MR. N. MCMANUS said that they were all indebted to Mr. Paterson for putting the matter of costing in a form understandable to "the

man in the street." They usually had it explained to them in a way that took hours to understand, even when they were able to read it. He very much wished that all foundries would get into the way of making out a proper cost of the castings they produced. He had recently had submitted to him a casting which weighed 32 lbs. and required a great deal of coring, which he was told was being quoted at 9s. The following week another casting weighing 2½ cwts. which was fairly simple, with hardly any cores, was submitted, and that was quoted at 19s. There was something wrong when such different prices were quoted. It appeared to him that the light casting should have been quoted at about 45s., and he said good luck to the firm quoting 9s. Give them as many as possible.

Influence of Design on Costs.

Mr. Lawrie said that cost was a thing he knew little about, although he had his own opinions on the subject. The little man could compete successfully against the big fellow because he had practically no overhead charges. A man worked away in the corner of a shop on his own, gave a good output, and there were no department costs. If that man was shifted to another job he made something else at another cost. A general or jobbing shop represented a difficult problem to arrive at the cost of the castings. A flat plate or light casting might require a head having in it twice as much metal as the casting, and there was waste metal there. A compact casting might require very little head, and he wondered how the man in the office could know about that. A small cylinder might be made in the same department as an anvil block, which required no cores or hangers. The cylinder might be only a few cwts. and require a quantity of cores, gratings, etc. The small cylinder, when it went to the fettling shop, might require more time to get out the cores than the time required to mould the anvil block. In the face of these facts he could not see how it was possible for an office man to get the cost in a general shop.

Simplicity in Systems Desirable.

Mr. J. Longden said he felt very grateful to Mr. Paterson for the method of approach he had outlined. He had refrained from giving them the usual mass of figures, and had given them the first principles. He felt that the Paper would well repay a close study and careful reading. Mr. Paterson had pointed out how some founders sold castings much below cost and made it up on something else. He thought that Mr. Paterson would agree that, whilst costing systems might be built up on the basis of the system he had outlined, any given foundry might differ in the result from any other. If, as suggested by the lecturer, the Scottish Branch advocated a standard system, he thought that Mr. Paterson's assistance would be very valuable. The lecturer started with the plea for simplicity in cost systems, but he felt that he had in the end left them with a very complicated departmental system. It seemed to him that a compromise might be arranged to give a figure nearer the truth than a very detailed system. He supposed that there was no founder who favoured having no cost system at all, and Mr. Paterson's Paper would prove most valuable. Everyone should have some system of costing.

Founders' Attitude towards Cost Accounts.

Mr. A. S. Murdoch said that, as a visitor, he appreciated the privilege of being allowed to make a few remarks on the importance of knowing what a casting cost to make. He said that he often had the feeling that the atmosphere or the mentality among founders towards cost accounts was very much like the Chancellor of the Exchequer who asked the meaning of "those damned dots." He hoped, however, that he was wrong. The main object of a costing system was to enable them to avoid selling at a price below the article's cost. The lack of a system in many foundries was a menace to the whole industry. It happened at present that people did not have any idea of what the castings really cost and quoted on guesswork figures. Mr. Lawrie had said it was difficult to obtain the cost in a jobbing shop, as the office man did not know the circumstances obtaining in the shop. He agreed that a costing system should be as simple as possible and thought that moulders', coremakers' and fettlers' costs would be quite simple even in accountants' offices if they would only take into their confidence the men most concerned.

Accuracy in costing was another important point; the need for greater care was shown almost weekly. Recently he had quoted for a casting which they estimated at 30 tons and were told that they were double the weight. He asked a friend to take it out for him, and he made it 31. He pleaded for a simple system, but could not see much hope for a standardised system. He considered that in conjunction with the cost system they should study the estimated figures, and he thought it would be found instructive to make the comparison in every case. He also thought the cost per man-hour or man-day should be taken out in all cases, and it would make towards more efficiency. He strongly appealed to the whole industry to adopt some proper system of determining what castings cost them, as it was a vital matter concerning the whole Scottish industry.

Vote of Thanks.

The Branch-President said he was sure that Mr. Paterson would feel that the time he had devoted to the Paper had been well spent on account of what the various speakers had said. Mr. Lawrie had stated that he thought the shop with the least machinery was best placed in regard to costs, and he would like to say that those of them who had machines had to remember that they did not get them for nothing. He proposed that a very cordial expression of their appreciation of Mr. Paterson's Paper and his kindness in coming before them be recorded.

Mr. Paterson said that he appreciated the manner in which they had listened to the Paper and was well rewarded if he had succeeded in interesting them. As he had said in opening, he had started out to give only a modest Paper with the object of putting before them the first principles as he thought of them, but he would certainly say that simplicity was the most important requirement, so that the man in the shop could understand the system. He agreed that the cost accountant should take into his confidence the man in the shop.

Iron and Steel Import Duties Abroad.

The memorandum printed in the F.T.J. last week, which was addressed to the President of the Board of Trade by Sir Francis Joseph, Chairman of the Central Pig-Iron Producers' Association, was accompanied by a number of statistical tables supporting the claim put forward for a measure of protection against imported material being granted to the home iron and steel industry. The following table, showing the import duties per ton on certain iron and steel products in the United States of America, Germany, France and Belgium, is taken from the memorandum :—

	Pig-iron.	Blooms, billets, etc.	Beams and joists.
	s. d.	s. d.	s. d.
U.S.A.	4 8	20 per cent. *ad val.*	20 per cent *ad val.*
Germany	10 0	15 0	25 0
France	8 3* (Plus turnover tax of 2 per cent.)	23 5	23 5
Belgium	0 9½ (Plus turnover tax of 1 per cent.)	2 4½	6 3

* Forge and foundry pig-iron.

Catalogues Received.

Electrodes for Welding.—Steel founders and manufacturers of light iron castings are both becoming very interested in coated electrodes for welding up surface defects. As we had just been present at Mr. Pearson's recent lecture on "Welding in the Steel Foundry," we were more than usually interested to receive from Messrs. G. Dikkers & Company (England), Limited, Avenue Chambers, Southampton Row, London, W.C.1, their Brochure No. LE27, which covers in great detail the properties of the "Elarc" brand of electrodes. These are of the coated variety, and are made in 10 different types for various purposes, ranging from overhead welding to soft machinable grey iron. Though ten types are described, there is still room for extension, as we note that no provision is made for stainless and other well-known special steels, excepting, of course, manganese steel, which is covered by two brands.

Furnace Lighters.—A French firm, Le Canadien, 14 rue de Naples, Paris, has sent us a four-page brochure in French, which stresses the economies to be derived by using the "Canadien" fire lighter instead of wood for starting up cupolas. We are told that to light a 5- to 7-ton an hour cupola one uses 2 cwt. of wood costing 2s. a cwt., or, say, 4s. each run. To light it with four "Canadien" lighters costs about 2s. 6d., and shows a saving of 1s. 6d. a day. As the lighters take up less room, it seems quite an interesting proposition in France. Of course, all these figures refer to French conditions.

Publications Received.

The Activities of the Pearson & Knowles Engineering Company, Limited.—This company, which is now connected with the newly-formed Lancashire Steel Corporation, Limited, of Warrington, has had the good sense to prepare a well-printed and excellently-illustrated brochure, which is designed to give a clear picture of what this concern has done and can do in the field of engineering. It is divided into nine sections, bearing the following captions:—Iron and Steel Constructional Work; Blast-Furnaces and Steelworks Plant; Colliery Plant; Carbonisation Plant; Electric Welding; Wagon Wheels and Axles; General Engineering Work; Constructional Materials and Galvanising. As representing the foundry industry, we suggest that a little more stress might be placed on the ability of the firm to make castings.

Pumps.—Blackstone & Company, Limited, Stamford, Lincs, have in their publication No. 468 presented the engineering world with an extremely thoughtful technical description of their various types of "unchokeable" pumps. A tear-out data sheet has been included for ease in preparing estimates.

Temperature Chart.—Messrs. August's Muffle Furnaces have sent us a copy of their Fahrenheit and Centigrade thermometer scale, showing the melting and critical points of metals and ferrous alloys. This chart is extremely intelligently arranged, and justifiably finds a place on the office walls of most foundry executives.

Sir Horace Wilson, chief industrial adviser to the Government, addressed a meeting attended by leaders of Tees-side industry last week, at which it was agreed to appoint a committee to discuss the question of a North-East Coast Development Board with the object of developing local industrial resources and attracting new industries. The need for co-operation with Tyneside was emphasised at the meeting.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 158.)

No. 1. SALES LETTERS—(*continued*).

If a writer knows what he wants to say and has put himself into the right frame of mind, he will have gone a long way towards a good letter; but there are still further requirements. Of these, the first is good expression; the second, brevity; and the third, sincerity. Good expression is largely a matter of mechanics, or, in other words, of grammar and style. This article is not an essay on English composition, or a number of grammatical rules might here be inserted. The reader who needs elementary instruction in the use of our common language should apply himself diligently to some such work as "The King's English." All the points of grammar or style mentioned in these notes will be based on the assumption that at least a fair knowledge of grammar and syntax is possessed. They are in the nature of specialised instructions based on long experience in almost every form of commercial writing.

Value of Good Expression.

First and foremost, it is important to perceive the value of good expression. One does not demand of business men that they should understand the finer points of grammar or style. But vulgar or ungrammatical letters are inexcusable. Every post brings letters containing such solecisms as "in receipt of same," "equally as good as," or "different than," to mention but three. And the inevitable effect of such misunderstandings or misuses of a very beautiful language is to create an unfavourable impression. People are much more sensitive to well-written English than they imagine, or popular novels would be even more abominably phrased than they are. The educated man is jarred by every solecism. The less educated may not be jarred, but he will have an unsatisfactory feeling, as of something wanting, something wrong somewhere. A badly-phrased letter takes longer to grasp, even when it is not definitely misleading, as it often can be. *It pays the writer of letters to assume always that he is writing to an educated correspondent.* By so doing, he avoids irritating the educated, and while the uneducated or less educated may not appreciate the technical excellence of his letters, they will infallibly perceive that they are written by an educated man. That perception will modify the attitude they themselves take up when they reply. Whether they realise it or not, a certain respect will creep into their tone. Even correct spelling is less important than good phraseology. A duke may mis-spell, but he will never write "with regards to." It is amazing that a firm which would never dream of employing as representative a man with a vulgar accent will allow any Tom, Dick or Harry on its clerical staff to send out to customers letters that are neither grammatical nor well-phrased. Surely a cultivated "accent" in writing is as important as a cultivated "accent" in speech.

Faulty Constructions.

Hence the need for the writer of letters to study such an invaluable compendium as Fowler's "Dictionary of Modern English Usage," or any other sound book on construction and style. For those who have little time, the following table of weak or faulty phrases and constructions will be found useful. As far as possible, the reasons why these constructions are wrong or inadvisable are indicated below:—

"*In receipt of same.*"—"Same" is an adjective, and cannot be employed as a noun, unless the word "the" is prefixed. But "the same" is an old-fashioned, stilted expression, not used to-day by good letter-writers. In most cases the simple word "it" can be used. If this is not suitable, it is better to repeat the original noun, *e.g.*, "in receipt of it" or "in receipt of the goods."

"*Equally as good as.*"—If a thing is equal to another, it is as good as that other. To use both "equally" and "as" is unnecessary. Say "as good as," or alternatively: "This thing is equally good."

"*Different than.*"—A thing differs *from* another. Hence "different from," not "different than." "Different to" is sometimes used, but is incorrect, and is better avoided.

"*With regards to.*"—Incorrect. The correct phrase is "With regard to" or "In regard to."

"*Try and get.*"—A slovenly phrase. One tries *to* get a thing. The verb "try" cannot have for object the thing that is got, or the sense would be: "I will try an apple and get an apple," which is nonsense. Say "try to," never "try and."

"*We repeat again.*"—Another case of superfluity. To repeat a thing is to do it again. Say "We repeat" or "We say again." "To do a thing *over again*" is a similarly redundant phrase. Omit "over."

"*We are much obliged for your letter.*"—To be obliged is to be made indebted *by* something, not *for* something. "For," therefore, is incorrect, though often met with. "Much obliged by your letter" is correct, but ugly. It is much better to be simple and say: "We thank you for your letter."

"*We appreciate the letter having been written in this way.*"—Strictly, this means: "We, having been written in this way, appreciate the letter," which is nonsense. What is appreciated is the quality possessed by the letter of having been written in a certain way. Therefore, the possessive case must be used in all such instances, and the sentence made to read: "We appreciate the letter's having been written in this way." The logic of this will be seen when one examines the correct and similar phrase: "We appreciate your having written." Few would write "We appreciate you having written."

"*From thence we went . . .*"—The word "thence" carries with it the meaning of "from." "We went thence" means "we went from there." Say either "Thence we went" or "From there we went."

"*The tool consists in a number of carefully screwed parts.*"—"Consists in" can only be used as a definition, *e.g.*, "his philosophy consists in taking things as they come." Any material object, such as a tool, consists *of*. An important distinction.

"*We had wished to have received.*"—This is clumsy and ungrammatical. The writer means that he had wished to receive something. Why does he not say it? "We had wished to receive" is the correct and better form. There is no reason to use two past tenses to express one past action. This is a very common error, *e.g.*, "We should have been the first to have acknowledged," for "we should have been the first to acknowledge."

"*Broadly speaking, that is correct.*"—This error, and all like it, are among the commonest errors in business letters, and the surest sign of imperfect English. The real meaning is: "I, speaking broadly, tell you that that is correct." What the sentence actually says is: "That which is broadly speaking is correct." The error is known as the "wrongly attached participle," and should always be avoided.

"*This and your previous excuses do not satisfy us.*"—Another common error. "This" here attaches to "excuses," i.e., a singular to a plural. Say: "This excuse and your previous excuses do not satisfy us," or, better, "Your previous excuses did not satisfy us, nor does this one."

"*The letter in my possession, and which I have referred to earlier.*"—A frequent error in commercial letters. "And which" should only be used after an antecedent "which," *e.g.*, "The letter *which* I possess, *and which* I have referred to. . . ." In the example given, there is no antecedent "which," so that the "and" becomes superfluous. Write: "The letter in my possession, *which* I have referred to earlier."

"*Your continued delay in this matter is very aggravating.*"—To aggravate is to make worse, not to irritate. Say "irritating." On the other hand, it is correct to say: "Our trials are aggravated by your continued delay," because this means that they are actually made worse.

"*At least one individual in our works has complained.*"—"Individual" is a clumsy word in this sense, and good writers shun it. Say "man" or "person."

"*Excepting ourselves.*"—Say "except." The use of "excepting" is special and limited, and should be studied.

"*After what transpired yesterday.*"—To use "transpire" in the sense of "happen" is wrong, though frequently found. It can be used legitimately in the sense of "become known," but it is a shoddy word nowadays, and should be avoided.

"*I shall be glad if you would.*"—Future tense employed with conditional tenses should agree. Write: "I shall be glad if you will" or "I should be glad if you would."

"*Awaiting your kind reply, Yours sincerely.*"—This is known as the "hanging participle." It is incorrect because unfinished. Who is awaiting? Write: "Awaiting your kind reply, I am, Yours faithfully," or "I await your kind reply."

"*We have written him to-day.*"—This is a bad fault. You cannot write a man, though you can write *to* him. Say: "We have written to him." The fact that the error is a common one in business letters does not prevent it from being what it is, a vulgar error.

"*I wrote to you yesterday re the tools you ordered.*"—The word "re" is a legal technicality, and should not be used in any other than a strictly legal connection. There are plenty of good English phrases: "In reference to," "in connection with," "in regard to," that can be used instead.

"*I wired you as per enclosed confirmation.*"—Indulgence in needless Latin words is to be avoided wherever possible. The word "per" is quite unnecessary here. The "as" does all that is required.

"*Yours faithfully, J. Smith, p.p. T. Jones.*"—The use of "p.p." (the meaning of which few could indicate accurately) to signify that another person than he indicated by the signature has signed the letter is common and objectionable. It is common because business letter writers love these Latin tags, and objectionable because it is affected and needless, since the word "for" is quite sufficient for the purpose, *e.g.*, "for John Smith, T. Jones."

"*Soliciting your kind favours.*"—"Soliciting" is even worse than "begging." Good modern business letters omit it entirely.

"*We claim that our goods.*"—A common and an irritating phrase, especially in sales letters. It is usually followed by general statements that cannot be (or are not) substantiated, such as: "that our goods are unrivalled for quality." Claim nothing in so many words. Tell the facts, and let the reader's intelligence do the rest.

"*Dear Sir or Madam.*"—Another lazy phrase, showing that the writer has not taken the trouble to find out the sex of the person to whom he is writing. If he does not know it, and can't find out, he should plump boldly for "Dear Sir." Mistakes are pardonable. Laziness and indifference are not.

(*To be continued.*)

Institute of British Foundrymen.

ANNUAL DINNER OF THE NEWCASTLE BRANCH.

The annual dinner of the Newcastle and District Branch of the Institute of British Foundrymen was held on February 14 at Rinaldo's Restaurant, Newcastle-upon-Tyne. The principal guests were the Deputy Lord Mayor of Newcastle (Alderman Walter Lee, J.P.) and the Deputy Lady Mayoress, Dr. E. C. Edgar, F.I.C., Principal of Rutherford Technical College, Mr. F. P. Wilson, President of the Institute, and Mr. T. Makemson, General Secretary.

The Future Prosperity of Tyneside.

After the toast of "The King" had been proposed by the Chairman (Mr. A. Logan, Branch-President), Mr. V. Stobie (Junior Vice-President of the Institute) proposed the toast of "The Prosperity of Tyneside," coupled with the name of the Deputy Lord Mayor. Mr. Stobie explained that it was their custom not to toast Newcastle alone because their members resided right along the banks of the Tyne from one end to the other. Tyneside was a noble subject to toast, for a trip along the Tyne would show the fabrication of huge ocean greyhounds; the smelting of irons and forming of masses of iron and steel to go to all parts of the country; the mining of coal by the millions of tons for the warming of the world. With that panorama in front of them, well might they ask themselves what was the future of Tyneside. In one way it ought to be a very bright one, for to-day they could build mightier vessels than ever; they could forge and cast greater masses of material.

In spite of that, Tyneside to-day found itself in difficulty. The high cost of their production was causing buyers to lose interest. If they could reduce the cost of production, he would say that Tyneside's future would be bright. What was necessary to bring about that end? It was to cut down the enormous consumption of unnecessary luxuries in which England and every country indulged to-day. That did not mean that one should live a simpler life, but should go in for less of the unnecessary things of life; that they should treat life as somewhat serious. Most people would ask what difference to manufactures a high expenditure on luxuries made. He trusted that they would agree with him that it applied in the following way: when useful commodities were made, the cost of production included the cost of the unnecessary luxuries which have been consumed whilst the necessary articles were being made. Surely if people really wanted to get back happier days, it would not be a great sacrifice for them to limit their requirements of luxuries to what they were then. That did not mean that they would have to do without wireless or such things which had been developed since; it was in constantly-recurring luxuries. When he was young he had lived in France for several years, and in those days the finest gloves, hats, boots and shoes and soap in the shops in Paris were sent from England. But that was not the case to-day. There would be very few of those present who had not worn French or American shoes; how many of the men there had not worn Austrian hats? England used to be the workshop of the world; Tyneside had produced the greatest ships in the world before the war, but to-day other countries were building great Transatlantic liners. If they would only be a little more serious in those matters the future of Tyneside would be really great, but they could not continue in the way they were doing.

In responding to the toast, the Deputy Lord Mayor said that the loss of prosperity on Tyneside at the present time was the aftermath of the war; they were faced with competition from the whole of Europe. In Italy, for instance, they were not handicapped by politicians, their commerce, trade and industry were separate from their political life. England must first of all have revenue and international commerce before they could afford a higher standard of life than other countries. Mr. Stobie had suggested that they should curtail their personal extravagances, but he did not think that that would in any way affect the situation. To-day almost every civilised country had tariffs restricting the import of commodities. In his mind, the only economy would be to curtail the extravagance of the Civil Service and local council and Government offices. Whether they paid income tax directly or indirectly, they were dependent on the international flow of commerce to keep the country alive.

Technical Education.

The toast of the Institute of British Foundrymen, coupled with the name of Mr. Wilson, was proposed by Dr. E. C. Edgar, F.I.C., the Principal of Rutherford Technical College. Referring to the technical education of foundry apprentices which they of Rutherford College, together with the representatives of the Newcastle Branch, had been trying to get going for the last eighteen months, he paid a tribute to those gentlemen who had joined with them at the College in starting the class. They had spent much time not only on the task of evolving the large outlines of the scheme but also on preparing the wearisome details. He had to give a special word of praise for Mr. Colin Gresty; in fact, he doubted whether there would have been a foundry class if it had not been for him. He had attended every meeting and had been specially interested in the propaganda side of things. He had also suggested that as the theoretical lectures would not be likely to hold students for four years, they should have a workshop of their own. Messrs. C. A. Parsons & Company, Limited, had agreed to give them the use of rooms in Shields Road, and they had entered into a four years' tenancy. They had had an entry list of 69 students.

Two Great Men.

Mr. F. P. Wilson, President of the Institute, replied to this toast. He congratulated Dr. Edgar on the steps he had taken, in conjunction with members of the Newcastle Branch, in founding classes for foundry apprentices. Unfortunately the membership of the Newcastle Branch was not so high as it had been, but it was still a very strong branch in spite of that, and he noticed that it was nearly twenty years old. What was extremely interesting also was that the Newcastle Branch had a very flourishing Junior Section. They had only supplied one President to the Institute, Mr. R. O. Paterson, in previous years, but he was very glad to think that in two years time Mr. Stobie would be filling that office. Two of the great men of the North had died that week, Sir Charles Parsons and Sir Arthur Dorman. Sir Charles Parsons had done so much for engineering research and incidentally for developing the foundry industry by setting up a standard of design which required the best steel that foundrymen could make, and he was very glad to think that the foundries of Tyneside had been competent to produce the castings required. Sir Arthur Dorman was a great ironmaster and a good employer, one of the type that he was proud to think still existed, although there were not so many of them as they would like. The deaths of such great men reminded them that the older generation was passing away, and it was necessary to have men trained to fill their places.

The toast of "The Ladies" was proposed by Mr. T. Makemson, General Secretary, and replied to by Mrs. F. Sanderson on behalf of the ladies. There was also a vote of thanks passed to the Chairman, Mr. A. Logan, on the proposal of Mr. W. G. Paulin.

Researches in Cast Iron.

Dr. J. W. Donaldson, writing in the Royal Technical College (Glasgow) Metallurgical Club Journal, has summarised existing knowledge in the field of high-strength cast iron. Below we extract his views on growth (of which subject the Doctor is the recognised authority) and physical properties.

The tendency of cast iron to undergo volume changes, which are accompanied by reduction in the strength properties when it is heated to temperatures both below and above the critical range, has received a considerable amount of attention during recent years. As a result of these investigations the nature of growth particularly within lower-temperature ranges has been determined, and can be controlled by the use of suitable irons. Irons of low-carbon and low-silicon (under 1.0 per cent.) content when heated to a particular temperature show very slight volume increases, varying with the temperature, after short exposures. These increases are due to combined-carbon decomposition, and further increases due to oxidation in those particular irons are so slow and slight as to be almost negligible. Recent work by the British Cast Iron Research Association has resulted in the production of alloys possessing remarkable heat-resisting properties when tested in the laboratory and on an industrial scale at temperatures from 600 deg. C. to 1,000 deg. C.

A number of investigations have been carried out on the magnetic, electrical and thermal properties of cast iron, and also on the corrosion of cast iron. Partridge has shown that the highest magnetic induction and permeability values are obtained with cast iron which has been annealed, and that the various elements, silicon, etc., affect those properties differently. He also states that cast iron has a very high specific resistance, and that silicon, manganese and aluminium raise the resistance. The author determined the thermal conductivity of cast iron and obtained results, varying from 0.010 to 1.37, which decreased with increase in temperature. These values are affected by composition—silicon, nickel, manganese and vanadium lowering the conductivity of cast iron, whilst chromium and tungsten tend to raise it. Heat-treatment also affects this property, graphitisation being accompanied by a rise in the thermal value, a change which was also noted by Masumoto. An investigation on the corrosion and rusting of plain and alloy cast irons by Kotzsche and Piwowarsky has shown that the form and quantity of graphite does not affect corrodibility. With acid and alkaline solutions silicon should be below 1.5 per cent. to have the best resistance, while nickel up to 6 per cent. has little influence, and chromium up to 1 per cent. has a marked influence. Chromium and nickel together reduce attack by acids, but are of little use against salt solutions; and copper between 0.3 and 0.4 per cent. increases the resistance of grey cast iron to weather by 25 per cent., leaves it unaffected by acids, and reduces its resistance to salt solutions.

Mr. H. M. Lane, addressing a meeting of the New England Foundrymen's Association at Boston, U.S.A., referred to the remarkable results obtained with "Meehanite" cast iron. He stated that test-bars had been produced giving strengths as high as 29 to 33.9 tons per sq. in.

Vitreous Enamelling.

At a meeting of the Sheffield Section of the Institute of British Foundrymen, held at the Albany Hotel, Sheffield, on January 16, MR. J. H. D. BRADSHAW (of Messrs. Bradley & Foster, Limited, Darlaston) presented a Paper on "The Vitreous Enamelling of Cast Iron." This appeared in our issue of February 12.

Introducing the lecturer, the CHAIRMAN (the Hon. J. M. W. North) said that the process of enamelling had developed considerably in the last few years, particularly in its application to steel, as in the motor-car industry.

They had not, however, heard very much about the process of enamelling as applied to cast iron, and they would be glad to hear what Mr. Bradshaw had to say on the matter.

MR. BRADSHAW then read his Paper.

DISCUSSION.

Initiating the discussion on the Paper, the CHAIRMAN said that he had had no idea that the subject was so complicated. The Paper had given them a considerable number of facts. In the first place, he would like to know the minimum radius on corners that the lecturer would recommend for enamelling. There were many cases where the sharper the edge was the better it was from the point of view of appearance. Secondly, he would like to know why it was necessary to cast at high temperature. What difference did it make to the enamelling process? What would happen if they did not sand-blast the castings but cleaned them by other methods? Also, in regard to the third process of enamelling—that is, the cheaper one—it would be interesting to know the time that should elapse between the different coats that were put on. Perhaps, too, Mr. Bradshaw would tell them whether, instead of spraying, they sometimes dipped the castings in a bath of enamel. The Chairman put a further question as to the cost of enamelling per square foot and the differences of cost between the various methods of enamelling.

Cleaning the Castings.

MR. J. H. D. BRADSHAW, replying, said that from the point of view of enamelling the more liberal the radius on the corners of castings the better. In a case where they had a bead round the casting, the radius must be at least $\frac{1}{8}$ in. It was necessary that sharp corners should be removed, as the enamel would not adhere to a sharp corner. If the corner was rounded off, the effect would make all the difference between a good enamelled article and an inferior one. As to the effect of a high-casting temperature upon the enamelling process, strictly speaking, it did not have any bearing on it, but the iron should be cast high so that there would not be any "mis-runners." The majority of castings for enamelling were of the order of about $\frac{3}{16}$ to $\frac{1}{4}$ in. thick, and unless they had very hot metal there would be a kind of mist on the castings. So far as the question of cleaning instead of sand-blasting was concerned, if the castings were thoroughly clean there would not be any difference. He meant, that if the castings were absolutely clean, it did not matter by what method that cleanliness was obtained. The sand-blasting method, however, was perhaps the cheapest and the best method of attaining that end. There were various methods in vogue for the cleaning of castings—scraping, cleaning with pumice-stone, washing thoroughly with water and so on. The time that should elapse between the coats of enamel depended upon the size of the casting. A large casting would hold the heat much longer than a smaller one. It was a custom in the trade to enamel large castings, such as baths, sinks and lavatory pedestals, by dusting processes, because they held the heat longer than smaller castings. Stove parts, hollow-ware and articles of that description were smaller, and would cool fairly rapidly. If they took a bath casting just enamelled, it would take probably two or three hours before it was ready for re-enamelling. Thus, if they were going to do their baths by the swill method, they would want a very large shop, so that the baths could be placed in the roads to await their turn for re-enamelling. Smaller castings, varying in size from 1 to 2 or 3 ft., which cooled relatively rapidly, were always coated by the swilling process. Quite a number of castings were enamelled by the dipping method. In this method they had a vessel holding liquid enamel and dipped the clean articles into it. They were well shaken and allowed to dry and then fired. Hollow-ware, saucepans and work of that description was very often enamelled by dipping, and also by swilling. In the latter method, they poured the liquid enamel into the vessel, revolved it and then dried and fired it.

Pickling Castings.

MR. GREEN asked the lecturer whether they sometimes pickled the iron in acids, and whether such a method was advantageous.

MR. BRADSHAW said that he had conducted experiments on the pickling of cast iron for enamelling. Probably they were aware that steel was usually cleaned by pickling; that is, by immersing it in an acid bath, but so far as cast iron was concerned they encountered a different problem, for the reason that they had a large percentage of graphite in the casting and that during the pickling they dissolved away a certain amount of the iron and thereby exposed the graphite. In other words, they dissolved iron off the surface of the casting and the graphite projected and caused blistering. Pickling for cast iron was not to be considered, and it should not be attempted. Furthermore, apart from its effect in exposing graphite, there was another disadvantage in that it got into the pores of the castings and when the castings were re-fired the acids were eliminated and caused blistering on other work in the muffle. Then, also, the fumes floating about the muffle had an injurious effect upon other ware that was being fired at the same time and tended to produce dull and "pig-skinned" surfaces.

Sand-Blasting.

MR. J. H. GRAY (Birmingham) said that Mr. Bradshaw had told them in his address that sand only should be used for sand-blasting, and not steel shot, as the latter was liable to pean the casting. He had found certain disadvantages in the use of sand only. To overcome those disadvantages they had used an angular shot in addition to sand. They used 50 per cent. angular shot and 50 per cent. sand and found the results quite satisfactory. Mr. Bradshaw had also told them that as long as a casting was definitely clean in all respects it was satisfactory for enamelling. He was inclined to disagree with the lecturer on this point. If a casting was given one coat of enamel and after that one coat it was a finished article, the coat must, therefore, be glossy. Now with a wet process the enamel was applied direct, but the object of sand-blasting was not only to clean the casting but to make pores in the casting, so that when the enamel was spread over the casting and diffused the pores expanded, and during the cooling down the pores contracted and gripped the enamel, so that it would not chip or fly off.

MR. BRADSHAW, in answer to the first query, said that what he had in mind was the steel shot as used for cleaning castings in general routine work. It clogged the surface instead of giving the slightly-roughened surface that was required for enamelling to give a grip. Such a surface was destroyed when they used steel for the sand-cleaning operation. He had not tried the angular shot, but he should not think that it would be very successful, because the sand was so much harder than the casting and tended to break during the operation, thus creating a great deal of dust in the chamber, whereas a steel shot, being more plastic, did not tend to break but simply gave way under the force of impact. His own experience, however, was that the steel shot gave a more or less smooth surface, to which the enamel did not adhere.

MR. GRAY: I understood you to say that as long as a piece of cast iron was clean it would enamel satisfactorily in the wet process.

MR. BRADSHAW: Yes; I appreciate your point, and I think it was covered by my remarks. I said that filing or anything else that tends to produce a smooth surface should be avoided. For instance, take the pickling of iron; there is a tendency for a roughened surface to be produced. If you pickle cast iron you will certainly have a black deposit of carbon on your finger if you draw it across the casting.

Effect of Annealing.

MR. T. HAMILTON inquired as to whether it was necessary to anneal before sand-blasting, whether any particular grade of iron was advised to withstand the heat, and whether it was possible for the heat of the furnace to change the colour of the enamel.

MR. BRADSHAW, dealing with Mr. Hamilton's first question, said that it depended on the condition of the castings. If the castings were new ones straight from the foundry it was not necessary to anneal before sand-blasting. If, on the other hand, the casting to be treated was one that had been lying about for two or three days or two or three months and was in a rusted condition it was essential to anneal before sand-blasting. Then, too, if they were troubled with sand spots, annealing was the only method of eliminating them. Sand spots were one of the nightmares of the enameller, and for a long time the cause of them was unknown. It had now been found that by removing the castings as soon as possible from the sand the prevalence of sand spots was minimised and very often eliminated. Thus the question resolved itself into one relating to the condition of the castings. If they were good, clean castings straight from the foundry it was not necessary to anneal. If they were old and rusted castings that had been lying about they certainly needed annealing. The analysis of the mixture quoted in his Paper was one usually utilised in this country for the production of light castings of the type used for enamelling. Generally speaking, in the Birmingham district Northampton iron was used. Scottish founders used Cleveland iron, having a slightly lower phosphorus content. In regard to the question as to whether it was possible for the heat of the furnace to change the colour of the enamel. The factor that altered the colour of the enamel was whether they had an oxidising or a reducing atmosphere in the furnace. For example, if they had an enamel that was coloured red by means of copper oxide and they had an oxidising atmosphere in the muffle they would probably find that instead of getting a red enamel after firing they would have a green one. Further, the heat of the muffle did certainly have an effect upon an opaque enamel in so far as the higher the temperature, other things being equal, the more transparent would become the enamel. That meant to say that they would get a more opaque enamel at a lower temperature.

Leadless Enamels Defined.

MR. B. R. LAING said that once or twice the lecturer had spoken of leadless enamel. He would like him to define what he meant, and to say if he really meant enamel that was actually free from lead content.

MR. BRADSHAW replied that by leadless enamels he meant enamels that were entirely free from lead.

MR. LAING thereupon asked if there was any difficulty in the application of leadless enamels as compared with that of lead-containing enamels.

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Mr. Bradshaw said that it was far easier to apply lead-containing enamel than enamel that was leadless—that is by the dusting process. By the swill method there was no difference. Lead-containing enamel invariably had a higher gloss.

Manganese and Phosphorus Contents

Mr. E. Wharton asked what Mr. Bradshaw's objection was to having a high manganese in the iron. He also inquired what fineness of the frit Mr. Bradshaw would recommend and how he determined what the fineness should be.

Mr. Bradshaw replied that when he referred to high-manganese content, he meant high manganese plus high phosphorus. If they had a high-phosphorus iron they did not require high manganese, otherwise there would be some difficulty in the furnace when they fired. Both these elements have an embrittling effect on the iron. When both the manganese and the phosphorus were high there would be a double-embrittling effect. Therefore, if they were obliged to work high-manganese iron they should by all means lower the phosphorus. On the other hand, if they had a high phosphorus, they should keep their manganese down. In regard to the fineness of the ground frit, it depended upon the method that had been used for grinding. It was well known that they could grind to a much finer state by wet grinding than by dry. Usually the fineness was of the order of 80 to 100 meshes for wet application.

Mr. Wharton: I was thinking of the dry.

Mr. Bradshaw: For dry application you want about 120 mesh; that is, as supplied to the enameller. The fineness depends upon the time it is allowed to grind in the mill.

Maturing Wet-Process Enamels.

Mr. Gray remarked that Mr. Bradshaw had said that if a wet-process enamel was laid by for two or three days before being used it would give a better effect. He would like the lecturer to tell him what effect took place during the ageing period.

Mr. Bradshaw replied that the question resolved itself into one of maturing. If the enamel, direct from the mill, is tested by rubbing with one's fingers, it had a more or less gritty feel. After standing for a few days that grittiness appeared to go. If they coated a casting with a swill enamel that had just come from the mill and dried and fired it, nine times out of ten they would find that the enamel would part in the muffle. He had experienced that. If they let the enamel stand a few days and mature they would find that the parting effect had disappeared. What had actually taken place had not been ascertained, but certainly something did happen, as proved by the results obtained.

Vote of Thanks.

Proposing a vote of thanks to Mr. Bradshaw, Mr. J. E. Hurst said he believed that the Paper was the first that Mr. Bradshaw had given before the Institute. Mr. Bradshaw had dealt with the subject in a thorough manner, and the number of questions that had been asked showed the interest taken in the matter. The subject was one of which very little information was usually available, and he was sure they would all look forward to seeing the text of the lecture in print so that they could study the details more closely. The vote was seconded by Mr. W. A. Macdonald.

Graphite Crucibles may be protected from oxidation by painting them externally with a mixture of finely-powdered graphite material and water-glass, adding about 4 per cent. soda ash. Three applications of this should be made.

Messrs. John Brown & Company, Limited, Atlas Works, Sheffield, have booked orders for 700 steel tyres, 24 pairs of tyred wheels and axles, and 76 nickel-steel axles, for a tramway system at Montevideo, and a quantity of springs for the Buenos Aires tramways. In addition, the company are executing a South American order for 1,250 beater bars, for threshing machines.

Cupola Limestone.

By W. H. Bleeke.

Intensive study has been given of late to the coke, pig-iron and scrap components which constitute the greater part of the normal cupola charges. The scientific research extended to these materials emphasises the lack of attention paid to the other charge constituent, namely, limestone. The following notes are concerned with a few practical suggestions regarding this charge component.

The term limestone is applied by foundrymen to a rock consisting essentially of calcium carbonate ($CaCO_3$). Its general application includes rocks which contain amounts of magnesium carbonate ($MgCO_3$), and these are known as dolomites or magnesian limestone, whilst it also includes chalk and the marbles, which, chemically, are limestones. Limestones containing silica are named siliceous limestones. Argillaceous limestone, as its name infers, has clay within its structure. Limestones vary in colour from a pure white to a black, the intensity and variation in colour depending chiefly on the nature and extent of the metallic and earthy materials present.

The function of the limestone in the cupola is to flux away, by forming a fluid slag, the foreign matter of an acid character which is present during the melting procedure. In the cupola the origin of the ingredients which eventually constitute the slag are:—(*a*) Ash from the coke, (*b*) sand and oxides from off the pig and scrap iron, (*c*) lime from the flux employed, (*d*) oxidation losses, occurring by the formation of the oxides of silica, iron and manganese and (*e*) erosion products from the lining and daubing; these impurities, of which silica constitutes about 50 per cent., combine with the lime (CaO) to form complex silicates.

The amount of limestone required varies with the amount of the impurities, previously enumerated, which are charged into the cupola with the stock and also those which are contained within the limestone itself. The foreign element in the stone which is most undesirable is silica, and this may be present up to 6 per cent. in cupola grades of limestone. The presence of impurities in the stone present, when taken in their entirety, a fourfold disadvantage. (1) They need a certain amount of the lime to neutralise them, as the flux must neutralise its own impurities as well as those of the charge; (2) the presence of impurities in the stone increases the fuel consumption, as the amount of slag formed is greater, and this requires heat for its formation, which is taken from that of the coke combustion; (3) their presence reduces the amount of available lime in the limestone, and (4) these effects are reflected in the smaller output or lower melting rate obtained. For use in the cupola, founders would be well advised to draw up a specification for this item, similarly as they do for pig-iron and coke. A normal specification for limestone would state that the calcium carbonate content is to be at a minimum at 95 per cent. and silica to be present at not more than 2 per cent., the remainder consisting of iron oxide, alumina and magnesian carbonate. It should be of the hard, dense grade. Where low-phosphorus cast iron is being made the stone should be as free from this element, which may be present as apatite (calcium phosphate), as is possible. The flux should be of regular size and contain a minimum of "fines," as these retard the effective penetration of the blast and are frequently pieces of shale or clay.

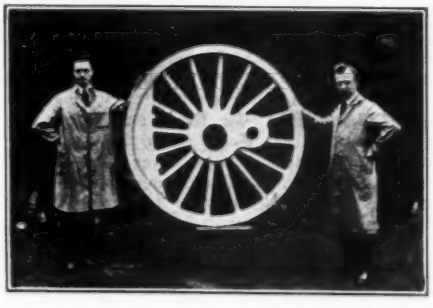
With normal working conditions using sand-cast pig-iron and unfettled return scrap comprising runners and risers, etc., together with coke containing about 7 per cent. ash, the writer has found additions to the amount of 30 per cent. of the coke charge is both economical and efficient. That is, employing an iron to coke ratio of 8:1, 84 lbs. of stone are required per ton of metal melted. Using 10-cwt. charges, the amount of stone necessary is 42 lbs. per metal charge. This in itself is very small, and here arises a point which is not infrequently missed. This amount is so small that if meticulous care is not practised the 42 lbs. needed may evolve under the furnaceman's shovelling into 25 or 60 lbs. of stone, with its decided disadvantages. Of course the exact weight is not practical nor necessary to obtain. The writer uses a tin can which just holds when full the correct weight to be added. This method eliminates guesswork and ensures definite and regular additions in flux. It has been found by experience that the limestone is best added after the metal charge and before the coke split. If placed first on the bed coke, the flux is liable to be melted first when the blast is put on, and it may cause trouble by solidifying in the metal tap hole. Research has found that for the maximum desulphurising power to be developed the lime content of the resulting slag must be at least 28 per cent. The above rate of addition, namely, 30 per cent. of the coke charge, gives lime contents in the slag of about this amount.

Summarising the previous considerations, good cupola limestone consists of at least 95 per cent. calcium carbonate, with silica not over 2 per cent., is hard, of regular size containing a minimum of fines, and the amount necessary varies with the extent of the impurities in the charge materials and is best added from a container of definite capacity, after the metal charge and before the coke split.

[It is high time that limestone additions were more carefully calculated in cupola practice. As the author correctly states, an eventual constituent of the slag is "erosion products from the lining and daubing." A better name for the erosion products would be solution products due to the action of excess limestone. The use of excess limestone causes enhanced patching costs. Insufficient will cause "hanging of the charge" and possibly dirty iron, and an effort should be made to hit the happy mean.—Editor.]

A Locomotive Driving-Wheel Pattern.

Our illustration shows the pattern for a locomotive driving wheel, made by Messrs. Walter J. Flavell & Company, The Tower Pattern Works, Carters Green Passage, West Bromwich.



A Locomotive Driving wheel Pattern.

The external diameter is 5 ft. 8 in., the face is 5 in. wide and there are 16 arms. The pattern naturally had to be made very exactly to ensure perfect balancing, and the method of construction adopted was as follows:—The rim was built up with five layers of segments, and the arms were worked separately to dead thickness and width. They were then V-shaped to the centre, *boxed* each side, divided up carefully and worked oval in position.

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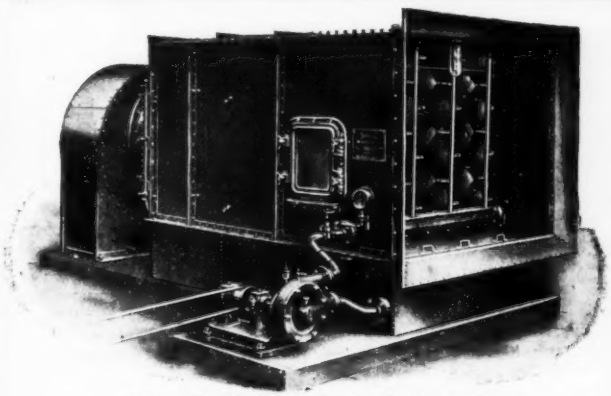

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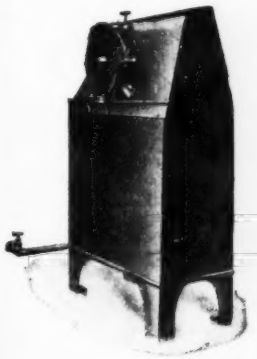

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Trade Talk.

The staff of the Coltness Iron Company, Limited, Newmains, Lanarkshire, recently held their annual whist drive and dance in the Newmains Public School.

The T.S.M.V. "Mermon," built by the Caledon Shipbuilding Company, Limited, completed successful trials last week. The vessel has been built to the order of Messrs. Alfred Holt & Company, Limited, Liverpool, and has a gross tonnage of 7,730.

A five-days' sale of plant, machinery and tools was opened recently at the naval construction yard, Dalmuir, of Messrs. William Beardmore & Company, Limited. The yard has been closed as the result of the rationalisation policy adopted by the shipbuilding industry.

Negotiations have begun between the Yugoslav Government and the Czech Vitkovice Company for the erection of a large smelting works in the vicinity of Sarajevo, in Bosnia, for the smelting of Bosnian ores. The Yugoslav Government is interested in the enterprise. It will pay for its shares in ore from the Ljubija and Vares iron mines.

Mining & Industrial Equipment, Limited, 11, Southampton Row, London, W.C.1, report that new orders have been received for the following equipment:—For England, a single-surface Hum-mer electric screen and a "Rovac" backwater filter; for Portugal, a Hardinge mill; for France, a Raymond separator; and for Russia, 16 Hardinge mills.

The partnership between Messrs. W. H. Jones, H. G. Jones, Leonard Jones and P. P. Jones, carrying on business as brassfounders, stampers and piercers, at 63, Bath Row, Birmingham, under the style of Jones & Barclay, has been dissolved. Messrs. H. G. Jones, Leonard Jones and P. P. Jones are continuing the business under the same style.

The members of the Falkirk District Ironfitters' Union held another successful musical contest in Falkirk on February 25. The winner in the vocal section was Mr. William Kelly, of Forth & Clyde & Sunnyside Iron Companies, Limited. In the instrumental section the prizes were divided between Messrs. J. Letham, A. Finlay and R. Morton. An innovation was introduced in the form of a challenge contest between Messrs. R. & A. Main's Gothic Foundry and the Forth & Clyde & Sunnyside Foundry, each works entering their three best singers. The judge was Mr. G. Kay, of Carron Company's Mungal Foundry, who had great difficulty in ultimately deciding in favour of Messrs. R. & A. Main's team.

The Long Service Association of Messrs. Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, held its ninth annual meeting and supper in the staff canteen on February 23. Sir Philip A. M. Nash, the President, was unfortunately unable to take the chair owing to illness, and his place was taken by Mr. G. E. Bailey. After the supper Mr. Walmsley, chairman of the L.S.A., opened the business meeting. The membership of the association had risen from 302 in 1923 to 1,142 at the end of 1930, the increase during the past year amounting to 122. A concert was given by the M.-V. male-voice choir and orchestra, and Mr. G. E. Bailey and Sir Felix Pole, chairman of Associated Electrical Industries, Limited, addressed the members, asking them to maintain their spirit of co-operation through the difficult time the industry was experiencing. A pleasant feature of the evening was the presentation to Mr. John Cameron of a framed photograph and a gold watch on his retirement after many years of service, and a cigarette box to Mr. Philip Lang as a token of the esteem in which he was held by everyone.

Government contracts recently placed include the following:—Admiralty: Nickel-steel cylinder-head bolts, Thos. Firth & Sons, Limited, Sheffield. Cast-steel brackets, F. H. Lloyd & Company, Limited, Wednesbury; Head, Wrightson & Company, Limited, Thornaby-on-Tees. Boiler plates, British (Guest Keen Baldwins) Iron & Steel Company, Limited, Cardiff; Park Gate Iron & Steel Company, Limited, Rotherham; D. Colville & Sons, Limited, Glasgow. Cast-steel shaft tubes, F. H. Lloyd & Company, Limited, Wednesbury. War Office: Iron cylinders, F. Francis & Sons, Limited, London. Pig lead, H. Gardner & Company, Limited, London. Galvanised corrugated sheets, Burnell & Company, Limited, Liverpool. Crown Agents for the Colonies: Axle boxes, Birmingham Railway Carriage & Wagon Company, Smethwick. Bolts and nuts, Nuts & Bolts (Darlaston), Limited, Darlaston. Rails and fishplates, Lancashire Steel Corporation, Limited; Barrow Hematite Steel Company, Limited; Cargo Fleet Iron Company, Limited. Steel rods: P. & W. Maclellan, Limited, Glasgow. Steelwork: Braithwaite & Company, Engineers, Limited; Head, Wrightson & Company, Limited, Thornaby-on-Tees; E. C. & J. Keay, Limited, Birmingham; F. Morton & Company, Limited, Liverpool; Tees Side Bridge & Engineering Works, Limited, Middlesbrough. Wire: Whitecross Company, Limited, Warrington.

Obituary.

Mr. Hugh Ross, a patternmaker employed by Messrs. R. & A. Main, Limited, Gothic Works, Falkirk, died on February 24.

Mr. Henry A. Wilson died suddenly in Wishaw on February 21. He was in his 80th year, and had served as steel dresser in the works of the Glasgow Iron & Steel Company, Limited, for 50 years.

The death has occurred, at the age of 90, of Mr. William Bishop, the last of the three brothers who were partners in the iron-founding and engineering firm of Messrs. Bishop Bros., North Street, Wellington, Som.

Mr. John William Smith, of Messrs. Smith & Fawcett, ironfounders, Horton Ironworks, Lidget Green, Bradford, died on Friday, February 27, at the age of 66 years. He and Mr. Joseph Fawcett founded the firm 30 years ago.

Contracts Open.

Bournemouth, March 11.—200 street lanterns, 200 wrought scroll irons and 160 cast-iron lamp-posts, for the Town Council. Mr. F. P. Dolamore, borough engineer and surveyor, Town Hall, Bournemouth.

Clown, March 17.—Steam pumping unit, for the Rural District Council. Mr. J. T. Pears, waterworks engineer, Council Offices, Clown, near Chesterfield.

Halifax, March 9.—Iron valves and connections, cast-iron pipes, etc., for the Gas Committee. Mr. W. B. McLusky, gas engineer and manager, Town Hall.

Hannington, Berks, March 10.—1,300 yds. of cast-iron mains, for the Kingsclere Rural District Council. Mr. W. A. Cooper, clerk, Kingsclere. (Fee £1 1s., returnable.)

Johannesburg, April 7.—Steel axles, tyres and wheel centres, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference G.X. 10,124.)

London, S.E., March 9.—Pumping machinery, for the London County Council. The Chief Engineer, The Old County Hall, Spring Gardens, S.W.1. (Fee £10, returnable.)

Oldham, March 16.—Travelling jib crane, for the Town Council. Mr. E. Parry, commercial manager, Gas and Water Offices, Greaves Street, Oldham, (Fee £2 2s., returnable.)

Plymouth, March 12.—6,000 yards of cast-iron pipes, for the Corporation. Mr. F. Howarth, water engineer, Stonehouse Town Hall, Plymouth.

Preston, March 9.—Centrifugal pumping plant, etc., for the Corporation. Mr. W. Platt, borough engineer and surveyor. (Fee £2, returnable.)

Rugby, March 16.—Pumping machinery, for the Urban District Council. The Water Engineer, Benn Buildings, Rugby. (Fee £3 3s., returnable.)

Reports and Dividends.

James Booth & Company (1915), Limited.—Dividend of 15 per cent., less tax, on the ordinary shares for 1930.

Delta Metal Company, Limited.—Net profit, £54,423; brought in, £13,582; dividend of 12½ per cent., with bonus of 2½ per cent., tax free; to reserve, £6,000; carried forward, £16,505.

Vickers, Limited.—Final dividends of 2½ per cent., less tax, on the preferred 5 per cent. stock and on the 5 per cent. preference shares, and of 2½ per cent., tax free, on the cumulative preference shares.

Clarke Chapman & Company, Limited.—Net profit, £83,838; brought in, £23,962; depreciation, £15,944; final dividend of 7 per cent. on the ordinary shares, making 10 per cent.; to reserve, £15,000; carried forward, £24,065.

Personal.

Mr. T. McPherson has been appointed general manager of the Wallsend Slipway & Engineering Company, Limited, in succession to the late Mr. Andrew Laing.

After completing fifty years' service as a blacksmith in the Hyde Park Locomotive Works, Springburn, Glasgow, Mr. Donald Brown has just retired. He was an outstanding personality in the works, and had the honour of being presented to the Prince of Wales by Sir Hugh Reid when His Royal Highness inspected the works a few years ago.

Mr. D. J. Barr, who for the past four years has been general manager of the Glasgow Iron & Steel Company, Limited, left last week to take up the position of managing director of Messrs. Wilsons & Clyde Coal Company, Limited. At a gathering of about 300 employees and officials Mr. Barr was presented with handsome gifts to mark the occasion. His successor will be Mr. W. Allison, who has been with the Glasgow Iron & Steel Company for 18 years as head of the sales department.

Mr. Alan J. Grant, who was recently elected President for 1932 of the National Federation of Iron and Steel Manufacturers, is joint managing director of Messrs. John Brown & Company, Limited, and a director of the Trent Iron Company, Limited, Cravens Railway Carriage & Wagon Company, Limited, Davy Bros., Limited, and Nasmyth, Wilson & Company, Limited. Mr. Grant, after leaving Cheltenham College, went as a pupil to Messrs Laird Bros., at Birkenhead, where he served a four years' apprenticeship. During this period he attended the Engineering School at Liverpool University, where Sir Oliver Lodge and Dr. Hele-Shaw were then lecturing. He obtained a Whitworth Exhibition in 1896, and was engaged on the staff of Messrs. Laird Bros. after finishing his apprenticeship. At that time Laird's were very active with Naval shipbuilding, and Mr. Grant had a lengthy experience in running 30-knot destroyer trials. In 1899 he was sent down to Devonport to erect the machinery in H.M. Battleships "Implacable" and "Montagu." He remained at Devonport for about three years. In 1904, Mr. Grant became general manager of Chadburns (Ship) Telegraph Company, at Liverpool, and was responsible for the telegraph installations in many notable vessels, including H.M.S. "Dreadnought." He joined the firm of Messrs. John Brown & Company, at their Atlas Works, as assistant to the directors in 1911. At the beginning of the war he was appointed a local director, and in 1919 a full director of the company, becoming managing director of the steel side of the business in 1929. Messrs. John Brown & Company have recently amalgamated with Messrs. Thomas Firth & Sons, Limited, and Mr. Grant is joint managing director of the new company.

Company Meeting.

Mather & Platt, Limited.—The annual meeting of Messrs. Mather & Platt, Limited, was held in Manchester on February 19. Mr. L. E. Mather (chairman) presided, and in the course of his speech said: Our home business in the aggregate has been reasonably good, but trade conditions overseas have led to a heavy fall in the order-book. One encouraging fact to record is an increase, in spite of tariff walls and depression, of textile machinery orders from the United States of America. During the year we have started a new activity, namely, that of manufacturing process machinery for the canning industry, for which we have already obtained substantial orders. This industry has developed to very large proportions in the United States of America, and it is from the United States that practically all machinery has been obtained until quite recently. There is, however, a natural desire on the part of those operating canning factories to obtain British plant, and, although we foresee considerable difficulties in meeting competition from overseas by well-established manufacturers, we are hopeful that our knowledge and experience will be of service to the industry. We look forward to the development of canning in this country with some confidence.

The Southern Railway has placed an order with Messrs. William Denny & Bros., Limited, of Dumbarton, for the construction of a third cross-Channel steamer.

TO BRITISH STEELFOUNDERS.

FOREIGN SANDS!

IS THIS THE TIME TO THROW MORE BRITONS OUT OF WORK BY BUYING STEEL FOUNDRY SANDS FROM ABROAD, AND ESPECIALLY FROM PEOPLE WHO SPEND THE REST OF THEIR TIME IN SELLING STEEL CASTINGS AT DUMP PRICES, AND ROBBING YOU OF YOUR TRADE?

ASK YOURSELVES!

General Refractories Ltd., Sheffield (Tel. 22311), can supply "YORKSHIRE SAND" in any strength desired, and at prices more economical than any foreign sand.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Trade generally is unsatisfactory in this area. Specially low rates are being quoted by Cleveland ironmasters to retain their Scottish connections, but Indian pig-iron is being offered at prices with which they cannot possibly compete. The past month has shown a further contraction in exports to Continental ports, and ironmasters are compelled to rely almost wholly upon a purely local demand for the disposal of their output. In the Cleveland area competition from outside sources has been largely overcome. Purchases of Continental and Midland iron for delivery on Tees-side have ceased, and deliveries under old contracts being almost complete, further danger from these sources has been—at least temporarily—eliminated. The steelworks are taking slightly increased quantities, but general consumers are strictly limiting their purchases to visible needs. Further orders for railway chairs for the L.M.S. placed in this district should tend to increase the consumption of pig-iron in Cleveland, and hopes have not been abandoned that business will improve as the spring approaches. Meanwhile, business is restricted to small parcels for early delivery at the following fixed prices:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

The pressure on hematite prices is being resisted by makers on the East Coast, but the disparity between foundry and hematite iron prices is much above the normal, and consumers are regulating their purchases in the confident belief that the gap will have to be narrowed. For small quantities of mixed numbers 69s. per ton is still a market figure, but purchasers who are prepared to buy more than a few truck loads might secure 68s., and export sales have been arranged at about that figure. The export trade, however, is very limited, and there are still substantial unsold stocks which bar the way to any increase in output. In the North-West of England, Bessemer mixed numbers are quoted at 68s. per ton at works.

LANCASHIRE.—The tone of this market is a little better, although it cannot be said that there is yet any inclination on the part of users to make forward purchases. Notwithstanding this fact, and notwithstanding the fact also that scrap iron is being employed in foundries to the utmost possible extent, Midland iron makers assert that there has been no falling-away in the total amount of pig-iron that is going into consumption in the Lancashire area. Prices are as follow:—Derbyshire and Staffordshire No. 3 foundry, 69s. 6d.; Northamptonshire foundry, 68s.; Derbyshire forge, 64s. 6d.; North-East Coast foundry, 71s.; Scottish foundry iron, 90s. to 91s.; West Coast hematite, 82s. 6d., all per ton delivered Manchester.

MIDLANDS.—There is little fresh business in this market, and the demand is poor. The ironfounders are finding a shortage of orders, particularly in the jobbing trades and the heavy section.

SCOTLAND.—Business in the Scottish pig-iron market is worse than ever, and there is an almost universal complaint of lack of orders. Most founders are on slack time, and in many cases works are closed for varying periods. The price of Scottish foundry iron remains at 73s. 6d. per ton f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. Middlesbrough iron remains in poor demand, but there are steady deliveries of Continental foundry iron. Continental No. 3 is obtainable at 54s. f.o.t. Grangemouth, against 60s. 6d. for No. 3 Middlesbrough.

Finished Iron.

In this market marked bars alone continue to show any sign of activity. Staffordshire marked bars remain at £12 10s. at works, and although the makers of this iron are better situated than those producing the cheaper grades, they are anything but busy. Crown and nut and bolt iron do not attract sufficient order to enable the works to operate efficiently. Crown-bar quotations continue to vary considerably and are at from £9 10s. to £10 5s., with nut and bolt quality from £8 15s. to £9. The Continental works receive a fair measure of support for the latter category, as their price is so much lower. Their prices at present range from £4 17s. 6d. to £5 2s. 6d. delivered to Black Country works.

Steel.

The demand for finished steel is still very poor. Keen competition prevails for the small amount of business available for small steel bars, but no further reductions in prices are announced. The sheet trade generally still lacks orders. The works making special grades of sheets are moderately engaged, but orders for common black working-up sheets are very scarce. Trade in galvanised sheets also is very slow, many mills being idle. Continental prices for semi-finished steel are again lower, and with the market in its present depressed state consumers are inclined to hold off in the hope of still lower prices. There is, in consequence, keen competition for any orders which may come on to the market. The British makers maintain steady figures on the whole, but it is reported that they have been willing to make concessions to secure a big tonnage.

Scrap.

Business in the iron and steel scrap market remains quiet, although in some cases a slight improvement has been reported. While complaints are rife in Cleveland regarding the limited opportunities for trade, there is a further grievance that consumers are delaying deliveries under contract where the price has gone against them and are buying at the lower levels now ruling. Ordinary-quality cast-iron scrap is quoted at 48s. 6d., good machinery quality at 51s. Cast-iron borings are difficult to sell at 25s. In the Midlands better deliveries are being taken, but there is no change in prices. For good heavy machinery cast-iron scrap in cupola sizes 57s. 6d. delivered is offered. Ordinary heavy cast iron is at 52s. 6d. to 55s., and light cast iron 37s. 6d. to 40s. No improvement is reported in the condition of the market in Scotland. Prices are unchanged, and little fresh business is passing. First-class machinery metal in pieces not exceeding 1 cwt. is at 55s. to 56s. 3d., and ordinary cast-iron scrap to the same specification is at around 50s. to 51s. 3d. The above prices are all delivered consumers' works

Metals.

Copper.—In this market the question which is at present engaging general interest is whether producers can, and will, raise their quotations, either to the 11 cents favoured by Wall Street or to any intermediate figure. Consumers in Europe throughout the week have been endeavouring to cover their future requirements at current rates. How much longer this buying wave will continue is doubtful, and the end of it is probably not far distant. Although buying has mainly been for forward delivery, considerable quantities of electrolytic have changed hands. The American domestic demand has not been very good.

Closing quotations :—

Cash.—Thursday, £46 15s. to £46 16s. 3d.; Friday, £46 10s. to £46 12s. 6d.; Monday, £47 3s. 9d. to £47 5s.; Tuesday, £46 13s. 9d. to £46 15s.; Wednesday, £46 7s. 6d. to £46 8s. 9d.

Three Months. — Thursday, £46 15s. to £46 16s. 3d.; Friday, £46 16s. 3d. to £46 17s. 6d.; Monday, £47 10s. to £47 11s. 3d.; Tuesday, £46 18s. 9d. to £47; Wednesday, £46 13s. 9d. to £46 15s.

Tin.—Following the announcement that an agreement had been reached regarding the international tin quota scheme, prices were further increased. At one time on Monday cash tin was quoted at over £123 per ton on the Metal Exchange. Later it eased off a little. However, so much was heard of the plan in advance that it was only to be expected that its effect should be to some extent discounted in values, and, as the improvement in prices during the past few weeks was mainly due to this one circumstance, it will not be surprising if a hesitating tone develops in view of the big increase in visible supplies. In America, consumers have been showing rather more interest in the market.

Official closing prices :—

Cash.—Thursday, £120 15s. to £120 17s. 6d.; Friday, £121 15s. to £121 17s. 6d.; Monday, £123 to £123 5s.; Tuesday, £122 7s. 6d. to £122 10s.; Wednesday, £121 7s. 6d. to £121 10s.

Three Months. — Thursday, £122 5s. to £122 7s. 6d.; Friday, £123 5s. to £123 7s. 6d.; Monday, £124 10s. to £124 15s.; Tuesday, £123 17s. 6d. to £124; Wednesday, £122 17s. 6d to £123.

Spelter.—The market has, on the whole, a better appearance. Consumers are inclined to follow prices with more interest, although, having covered their limited requirements at the lower level, they are dubious about the recent firmness. Stocks remain heavy, so that a sustained advance is hardly to be expected.

Daily fluctuations :—

Ordinary. — Thursday, £12 15s.; Friday, £12 13s. 9d.; Monday, £13; Tuesday, £12 17s. 6d.; Wednesday, £12 17s. 6d.

Lead.—Consumers remain to a large extent uninterested in the metal, and supplies are still greatly in excess of consumption. The recent expansion in demand appears to be diminishing.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £14; Friday, £13 18s. 9d.; Monday, £14 6s. 3d.; Tuesday, £14 2s. 6d.; Wednesday, £14 3s. 9d.

Accelerated Aluminium Chill Casting.

In a Paper presented at the French Foundry Congress, held in Paris last October, J. Polak compared the usual chill casting and die casting, and said that the former had the advantages of lower price of the mould and facility of casting and the disadvantages of deficient accuracy and comparatively high cost of production. The die casting had the advantages of extreme accuracy and of low production cost, its disadvantages being the higher cost of the mould and poor density of the casting. The author carried out researches with the idea of eliminating the disadvantages of the two processes and combining their advantages. To this end the first attempt was to use a cheaper pressure than pneumatic pressure, casting more slowly for the sake of the mould. In practice this object is achieved by using a hydraulic pump whose pressure on the metal can be adjusted according to the mould and usually is from 95 to 125 tons per sq. in. The cost of the mould under such conditions can be considerably less than that for die casting, but the casting is equally as sharp in outline as a die casting. Further, the casting is as dense as a chill casting and, lastly, the casting is obtained more rapidly than in chill casting and can even be as quickly cast as a die casting.—"Aluminium Broadcast."

An Invitation.

Members of the Institute of British Foundrymen are invited to participate in a meeting of the Institution of Welding Engineers to be held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, on Thursday, March 12, 1931, at 7.45 p.m., when A. B. Everest, B.Sc., Ph.D., will read a Paper entitled "Cast Iron To-Day." The Paper will be illustrated by lantern slides, and will be followed by a discussion. Free admission to the meeting can be obtained by ticket from the Acting Secretary, the Institution of Welding Engineers, 30, Red Lion Square, London, W.C.1.

STERLING FOUNDRY SPECIALTIES LTD. BEDFORD.
LONDON OFFICE —
13, VICTORIA STREET, S.W.1.
TELEPHONE :—
3345 BEDFORD.
TELEGRAMS :—
"STERFLASK, BEDFORD."
.....they play an important part in modern foundry production —— save unnecessary labour, produce accurate castings & reduce your Box Maintenance costs —
Sterling
SOLID RIBBED ROLLED STEEL
FOUNDRY MOULDING BOXES

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	46	7	6
Three months	46	13	9
Electrolytic	49	7	6
Tough	47	15	0
Best selected	48	5	0
Sheets	77	0	0
India	59	5	0
Wire bars	49	18	9
Do., April	49	18	9
Do., May	49	18	9
Ingot bars	49	18	9
H.C. wire rods	51	7	6
Off. av. cash, February	45	8	3¾
Do., 3 mths., February	45	6	1½
Do., Sttlmnt., February	45	8	1½
Do., Electro, February	48	4	4½
Do., B.S., February	47	5	0
Do., wire bars, February	48	9	9
Solid drawn tubes			11d.
Brazed tubes			11d.
Wire			7½d.

BRASS.

Solid drawn tubes	9¾d.
Brazed tubes	11¾d.
Rods, drawn	9¼d.
Rods, extd. or rlld.	5¼d.
Sheets to 10 w.g.	8½d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	121	7	6
Three months	122	17	6
English	123	0	0
Bars	125	0	0
Straits	124	12	6
Australian	122	17	6
Eastern	125	5	0
Banca	125	7	6
Off. av. cash, February	118	0	0¾
Do., 3 mths., February	119	9	3
Do., Sttlmt., February	118	0	3

SPELTER.

	£	s.	d.
Ordinary	12	17	6
Remelted	12	0	0
Hard	9	15	0
Electro 99.9	15	2	6
English	13	7	6
India	11	0	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., February	12	9	11½
Aver. spot, February	12	6	0¾

LEAD.

	£	s.	d.
Soft foreign ppt.	14	3	9
English	15	10	0
Off. average, February	13	9	11½
Average spot, February	13	8	10½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	21	0	0
Do., V.M. ex-whf.	20	5	0
Rods	24	0	0
Boiler plates	14	12	6
Battery plates	16	10	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	24	15	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 10 0
45/50%	£11 7 6
75%	£18 5 0
Ferro-vanadium—	
35/40%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 15 0
Ferro-tungsten—	
80/85%	2/– lb.
Tungsten metal powder—	
98/99%	2/3 lb.
Ferro-chrome—	
2/4% car.	£30 0 0
4/6% car.	£22 15 0
6/8% car.	£21 12 6
8/10% car.	£21 0 0
Ferro-chrome—	
Max. 2% car.	£32 0 0
Max. 1% car.	£35 15 0
Max. 0·70% car.	£37 17 6
70%, carbon-free	10d. lb.
Nickel—99% £170 0 0 to	£175 0 0
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0
76/80% packed	£12 0 0
76/80% export	£10 0 0
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales						
Heavy steel				2	7	6
Bundled steel and shrngs.	1	17	6 to	2	3	6
Mixed iron and steel	1	17	6 to	2	0	0
Heavy cast iron	2	8	0 to	2	9	0
Good machinery for foundries				2	10	0
Cleveland—						
Heavy steel	2	5	0 to	2	6	0
Steel turnings				1	12	6
Cast-iron borings				1	5	0
Heavy forge				2	15	0
W.I. piling scrap				2	11	6
Cast-iron scrap	2	8	6 to	2	11	0
Midlands—						
Light cast-iron scrap				1	17	6
Heavy wrought				3	0	0
Steel turnings					—	
Scotland—						
Heavy steel				2	7	6
Ordinary cast iron				2	10	0
Engineers' turnings				1	15	0
Cast-iron borings				1	12	6
Wrought-iron piling				2	15	0
Heavy machinery				2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	38	0	0
Brass	27	10	0
Lead (less usual draft)	12	0	0
Tea lead	9	0	0
Zinc	6	10	0
New aluminium cuttings	50	0	0
Braziery copper	35	0	0
Gunmetal	36	0	0
Hollow pewter	76	0	0
Shaped black pewter	56	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/–
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/–
Hematite No. 1	69/6
Hematite M/Nos.	69/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	76/–
,, d/d Birm.	86/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	66/–
,, No. 3 fdry.*	71/–
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	62/6
,, fdry. No. 3*	67/6
,, fdry. No. 1*	70/6
Derbyshire forge*	66/–
,, fdry. No. 3*	71/–
,, fdry. No. 1*	74/–
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	76/–
,, No. 3	73/6
Hem. M/Nos. d/d	74/–
Sheffield (d/d district)—	
Derby forge	61/–
,, fdry. No. 3	66/–
Lincs forge	—
,, fdry. No. 3	66/–
E.C. hematite	81/6
W.C. hematite	84/6
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
,, fdry. No. 3	69/6
Staffs fdry. No. 3	69/6
Northants fdry. No. 3	68/–
Cleveland fdry. No. 3	71/
Dalzell, No. 3 (special)	105/– to 107/6
Summerlee, No. 3	90/– to 91/–
Glengarnock, No. 3	—
Eglinton, No. 3	90/– to 91/–
Gartsherrie, No. 3	90/– to 91/–
Monkland, No. 3	90/– to 91/–
Shotts, No. 3	90/– to 91/–

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	10	0	0 to	10	10	0
Nut and bolt iron				8	15	0
Hoops	10	15	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip	10	15	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				14	5	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	9	5	0 to	10	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	7	5	0 to	7	15	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)	9	5	0 to	9	10	0
Black sheets, 24g.	8	10	0 to	9	10	0
Galv. cor. shts. 24g.				11	0	0
Galv. flat sheets				11	10	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	5	5	0 to	5	12	6
Billets, hard	7	2	6 & up.			
Sheet bars	5	0	0 to	5	12	6
Tin bars	5	0	0 to	5	12	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/–
Sheet to 10 w.g.	1/0¼
Wire	1/1½
Rods	1/–
Tubes	1/7
Castings	1/–

Delivery 3 cwt. free.

10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/– to 10 g.	1/4½ to 1/11½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	13.00
Basic	18.26
Bessemer	18.76
Malleable	18.76
Grey forge	17.76
Ferro-mang. 80%	80.00
O.-h. rails, h'y, at mill	43.00
Billets	30.00
Sheet bars	30.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/–
,, furnace	15/– to 17/–
Durham and Northumberland—	
,, foundry	13/6 to 14/–
,, furnace	13/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/3 to	15/6
,,	28×20 ,,		31/–
,,	20×10 ,,		22/9
,,	18¾×14 ,,		16/3
C.W.	20×14 ,,		15/–
,,	28×20 ,,		29/6
,,	20×10 ,,		21/–
,,	18¾×14 ,,		16/–
Terneplates	28×20		31/– per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, st'l	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ¼ in. up to 6 in.

	Tubes.	Fittings.
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
Feb.	26 ..	46 15 0 dec.	12/6
..	27 ..	46 10 0 ..	5/-
Mar.	2 ..	47 3 9 inc.	13/9
..	3 ..	46 13 9 dec.	10/-
..	4 ..	46 7 6 ..	6/3

Electrolytic Copper.

		£ s. d.		
Feb.	26 ..	49 10 0	dec.	15/-
..	27 ..	49 10 0	No change	
Mar.	2 ..	50 5 0	inc.	15/-
..	3 ..	49 15 0	dec.	10/-
..	4 ..	49 7 6	..	7/6

Standard Tin (cash).

		£ s. d.		
Feb.	26 ..	120 15 0	dec.	12/6
..	27 ..	121 15 0	inc.	20/-
Mar.	2 ..	123 0 0	..	25/-
..	3 ..	122 7 6	dec.	12/6
..	4 ..	121 7 6	..	20/-

Tin (English ingots).

		£ s. d.		
Feb.	26 ..	122 5 0	dec.	15/-
..	27 ..	123 0 0	inc.	15/-
Mar.	2 ..	124 10 0	..	30/-
..	3 ..	124 0 0	dec.	10/-
..	4 ..	123 0 0	..	20/-

Zinc Sheets (English).

		£ s. d.		
Feb.	26 ..	21 0 0	No	change
..	27 ..	21 0 0	..	..
Mar.	2 ..	21 0 0	..	..
..	3 ..	21 0 0	..	..
..	4 ..	21 0 0	..	..

Spelter (ordinary).

		£ s. d.		
Feb.	26 ..	12 15 0	dec.	7/6
..	27 ..	12 13 9	..	1/3
Mar.	2 ..	13 0 0	inc.	6/3
..	3 ..	12 17 6	dec.	2/6
..	4 ..	12 17 6	No change	

Lead (English).

		£ s. d.		
Feb.	26 ..	15 10 0	dec.	5/-
..	27 ..	15 10 0	No change	
Mar.	2 ..	15 15 0	inc.	5/-
..	3 ..	15 10 0	dec.	5/-
..	4 ..	15 10 0	No change	

AVERAGE MONTHLY PRICES OF RUBIO ORE (MIDDLESBROUGH).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1890	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 15 4	0 14 3	0 14 3	0 15 7½	0 15 7½	0 15 7½	0 15 2½
1891	0 15 7½	0 14 2½	0 14 2½	0 14 2½	0 13 6¾	0 13 6	0 13 3¾	0 13 0	0 12 11	0 13 0	0 13 7	0 13 1	0 14 0¼
1892	0 13 1	0 12 9	0 12 9	0 12 9	0 12 9	0 11 10½	0 12 1	0 12 1	0 12 2	0 12 0	0 12 0	0 11 11	0 12 4¼
1893	0 11 11	0 11 10	0 11 10	0 12 0	0 12 1½	0 12 3	0 12 1½	0 12 3	0 12 1	0 12 4	0 12 4½	0 12 6	0 12 0¼
1894	0 12 6	0 12 6	0 12 7½	0 12 1½	0 12 4	0 12 1	0 12 0	0 12 0¾	0 11 10½	0 12 2	0 12 0	0 12 0	0 12 1¼
1895	0 12 0	0 12 0	0 11 10	0 12 0	0 12 0	0 12 3	0 12 3	0 12 4	0 12 4	0 12 6	0 12 7	0 12 6	0 12 2½
1896	0 12 6	0 12 6	0 12 9	0 12 9	0 12 9	0 12 7	0 12 9	0 12 9	0 12 9	0 13 6	0 15 0	0 14 9	0 13 1
1897	0 15 3	0 15 6	0 15 3	0 15 0	0 14 0	0 14 3	0 14 3	0 14 0	0 14 0	0 15 0	0 14 3	0 15 3	0 14 8
1898	0 15 0	0 14 4	0 14 9	0 14 6	0 15 0	0 15 0	0 14 0	0 14 0	0 14 0	0 14 9	0 15 0	0 14 9	0 14 7
1899	0 15 0	0 15 3	0 15 6	0 15 6	0 15 9	0 16 0	0 17 6	0 18 0	0 17 9	0 18 0	0 19 0	1 0 0	0 16 11½
1900	1 1 0	1 0 6	1 1 0	1 0 9	1 1 0	1 1 0	1 1 3	1 1 6	1 1 3	1 1 3	1 0 0	0 18 0	1 0 8¼
1901	0 17 6	0 16 0	0 15 0	0 14 6	0 15 6	0 15 9	0 14 9	0 15 3	0 15 9	0 15 9	0 15 9	0 15 9	0 15 7½
1902	0 15 6	0 15 0	0 16 0	0 16 0	0 15 6	0 15 3	0 15 6	0 16 0	0 16 0	0 16 0	0 15 9	0 15 6	0 15 8¼
1903	0 15 6	0 16 0	0 16 6	0 16 3	0 16 3	0 16 10	0 15 9	0 15 6	0 15 6	0 14 9	0 14 9	0 15 1	0 15 8
1904	0 14 9	0 15 3	0 15 1	0 15 4	0 15 3	0 15 0	0 14 5	0 14 6	0 14 6	0 14 6	0 14 6	0 14 7	0 14 9¼
1905	0 15 3	0 15 6	0 15 0	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 16 6	0 18 6	0 18 9	0 18 9	0 16 3½
1906	1 0 0	1 1 6	1 0 0	1 0 0	0 19 6	1 0 0	0 19 6	0 19 4	1 0 6	1 1 6	1 1 9	1 3 6	1 0 7
1907	1 3 6	1 2 6	1 2 6	1 2 0	1 1 6	1 2 3	1 2 3	1 2 0	1 1 0	0 19 0	0 18 9	0 17 6	1 1 2½
1908	0 16 6	0 15 0	0 15 6	0 15 6	0 15 3	0 15 0	0 15 0	0 14 9	0 15 0	0 16 0	0 16 0	0 16 0	0 15 5¼
1909	0 15 9	0 16 3	0 16 0	0 16 0	0 16 3	0 16 6	0 16 0	0 16 0	0 17 0	0 17 6	0 17 6	0 17 6	0 16 6
1910	1 0 4	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 9	1 0 3	1 0 3	1 0 6¾	1 1 3	1 1 5	1 0 9¾
1911	1 2 2½	1 2 6	1 2 6	1 1 11½	1 0 11½	0 19 6	0 19 0	0 19 0	0 19 1½	0 19 6	1 0 0¾	1 1 6¾	1 0 7¼
1912	1 2 3	1 2 6	1 2 6	1 1 1¾	1 1 6	1 1 6	1 1 6	1 2 3	1 2 6	1 3 0	1 3 0	1 2 11	1 2 2¾
1913	1 2 9	1 2 2	1 1 7¾	1 1 6	1 0 8½	1 0 0	1 0 0	1 0 0	0 19 10½	0 19 1½	0 19 0	0 19 0	1 0 5¾
1914	0 18 7½	0 18 0	0 18 0	0 17 9	0 17 6	0 17 6	0 17 1¾	0 19 7½	0 18 11½	0 17 10¾	0 18 7½	1 1 0¾	0 18 5¾
1915	1 7 7½	1 8 6	1 9 3	1 10 2½	1 8 6	1 6 4	1 5 10½	1 6 0	1 6 10½	1 10 8½	1 13 0	1 17 10	1 9 1¼
1916	1 18 6	2 0 1½	2 2 6½	2. 0 6½	1 15 0	1 16 3	1 18 0	1 18 0	1 18 0	—	—	—	—
1917	} Price Fixed												
1918													
1919	—	—	—	—	2 5 7½	2 14 4½	2 16 4½	2 14 0	2 13 4½	2 18 0	2 12 7½	2 11 9	—
1920	2 17 0	3 7 9	2 15 6	3 6 7	3 0 0	2 15 0	2 14 0	2 9 9	2 7 6	2 11 0	2 12 3	2 10 0	2 15 0
1921	2 1 0	2 0 1½	1 18 3	1 17 6	1 17 6	1 17 6	1 17 6	1 5 0	1 8 9½	1 7 9	1 7 0	1 7 0	1 13 8¾
1922	1 6 7½	1 5 10½	1 6 11	1 7 0	1 7 0	1 7 0	1 5 3	1 4 9¾	1 4 2½	1 3 3¾	1 2 6	1 2 3	1 5 2½
1923	1 2 9¾	1 4 6¾	1 5 2	1 4 8½	1 4 6	1 4 0	1 3 6	1 3 0	1 3 0	1 3 0	1 3 2½	1 4 9	1 3 10¾
1924	1 4 2¾	1 4 0	1 4 0	1 3 7½	1 3 8½	1 3 6	1 2 11	1 2 6	1 2 1½	1 1 7½	1 2 3	1 2 6	1 3 1
1925	1 2 6	1 2 1½	1 2 0	1 2 0	1 2 0	1 1 6	1 0 6	1 0 0	1 0 0	1 0 0	1 0 3	1 0 10½	1 1 1¾
1926	1 1 1½	1 1 6	1 1 6	1 1 3½	1 1 3	1 1 5½	1 1 6	1 1 6•	1 1 0•	1 1 6•	1 1 6•	•	1 1 4¾
1927	1 2 1½	1 2 3	1 2 1½	1 2 0	1 2 0	1 1 7½	1 1 7½	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 7¼
1928	1 1 0	1 1 1½	1 1 11	1 2 4½	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 6	1 2 2½
1929	1 2 6	1 2 6¾	1 2 11½	1 3 0	1 3 0	1 3 2½	1 4 0	1 4 8½	1 4 7½	1 4 6	1 4 6	1 4 3	1 3 7¾
1930	1 3 3½	1 2 6	1 1 9	1 1 6	1 0 10½	1 0 0	1 0 0	0 19 6	0 19 0	0 17 4½	0 16 4½	0 16 4½	0 19 10½
1931	0 16 1½	0 16 0	—	—	—	—	—	—	—	—	—	—	—

• Prices nominal.

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